POWER

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Remember how, just a few years ago, most businesses were small and individual? They were centered about a dominating personality who was generally grown from the shop into the boss of all departments, and his word was law.

The competitors came. They crowded into his business field, with the facilities afforded by improved means of communication and transportation, better manufacturing tools and systems of distribution. So the plant proprietor was forced to modify the old method and extend his thinking into new fields. But he was still able to conduct his business, albeit not so happily, in his own way and from his own office at the shop.

Now this phase is relegated to the past by offensive-defensive alliances of companies having complementary interests, and the outgrowing changes in the methods of doing business.

Through it all, a number of the smaller companies have kept pace and fully proved their right to a place in the present system, but others, despite the high quality of their workmanship, are vainly striving to do business in the old way.

They will not succeed unless they adopt the accepted ways of their larger competitors, and extend their service, undertake research in their chosen fields, modernize designs to meet purchasers' requirements, and revamp plant facilities to reduce costs. Orders will come to those whose methods instill confidence, and who are well known to be qualified to handle them properly.

EDITORIALS

Power Commission Appointment Legal

Of the many conflicts between the last Congress and the President, none was more spectacular than that over appointing Dr. George Otis Smith chairman of the Federal Power Commission. A new commission, consisting of five full-time members, with Doctor Smith as its chairman, was appointed by President Hoover and submitted to the Senate for approval. After failing to get the chairman's pledge to support the ideas of certain Senators, the five commissioners were approved and the confirmation sent to the Chief Executive. When reorganizing the commission's office personnel two employees were dismissed whose retention was desired by a Senate public-ownership group.

Dismissal of these employees prompted the Senate to request the President to resubmit the nominations for reconsideration. This President Hoover refused to do, and the controversy was taken to the District of Columbia Supreme Court. Recently this court rendered its decision in favor of the President and found that "when the Senate, in conformity with its own rules, unanimously ordered notice of consent to be sent to the President it once and for all surrendered its control of the matter and its right to reconsideration and left the Executive free to make a constitutional appointment."

If the Federal Power Commission is to serve the best interests of the country it must give unbiased consideration to all matters that come within its jurisdiction. To do this it must be free from the machinations of any group regardless of whom it may represent. Political expediency is one of the gravest difficulties with which water-power development has had to contend, and the court's decision in favor of the President should help to control this interference.

Dual Firing For Peak Loads

A prominent European engineer some time ago proposed a novel boiler arrangement for systems having high peak loads. This involved large boilers with suitably sized furnaces equipped for dual firing with underfeed stokers and pulverized coal. The stokers alone would operate at low loads, and as the load increased they would be forced to their economic limit. Beyond this point of economical loading pulverized coal would be introduced above the stokers. Dependence for carrying at least 80 per cent of the peak would be placed on the pulverized-coal equipment.

In support of this arrangement it was contended that the stoker would operate at high economy at relatively low ratings and the combination would give uniformly high efficiency at all loads; the output of the boiler would be greater than with either system alone; the stoker need not be of a size to handle the maximum peak; and the cost of boiler plant for a given steam delivery would likely be reduced.

There are many plants already in operation that have dual systems of firing, such as the natural-gas and oil combinations in the South and West, the sawdust-powdered coal plants in the Northwest and South, and the gas-refinery waste installations of certain oil companies.

Coal-burning central stations have adhered largely to one type of firing, because of the desire to avoid the complications of dual systems and the ability of some modern stokers to be operated at high ratings as readily and as economically as pulverized-coal furnaces.

While the application of dual firing under American conditions thus appears to have certain limitations, engineers cannot afford to overlook its possibilities and to apply such a system wherever conditions warrant.

Treating High-Pressure Boiler Feed

Designers and operators of boilers in the 1,000 to 1,400 pounds pressure class have felt considerable concern over conditioning of boiler feed water. Generally, evaporators have been installed to provide pure distilled make-up rather than employing chemical treatment alone, largely because data were not available upon which the solubilities of salts at the high temperatures and pressures in the boiler could be based. Moreover, data available for the temperatures corresponding to lower pressures have seemed to indicate greater possibilities of scale trouble at high pressures.

The work of F. G. Straub on the solubility of calcium salts, the results of which were presented at the annual meeting of the American Society of Mechanical Engineers, provides solubility data up to temperatures of 600 degrees Fahrenheit and pressures of 1,500 pounds per square inch. This information, theoretically at least, indicates that satisfactory chemical treatment of feed water for high-pressure boilers for the purpose of preventing scale is now possible.

Operators, however, have a natural antipathy toward experimentation when a miscalculation may jeopardize expensive equipment. It is desirable, therefore, that supporting tests in laboratory boiler set-up be made to determine how far static solubility data can be applied to actual boiler conditions. It is hoped that such tests will be performed in order that the excellent work of Mr. Straub will become of practical value.

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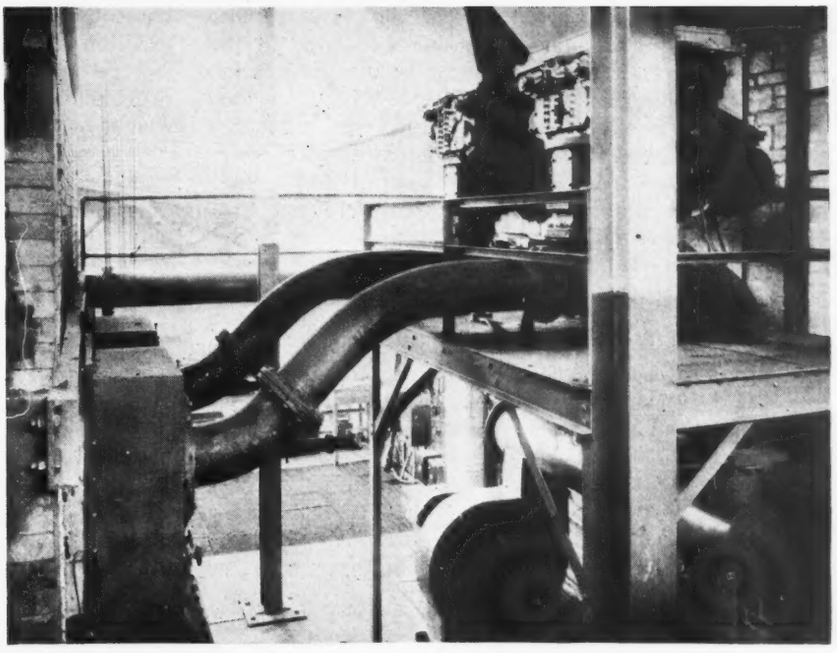
POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason



Pulverized-coal feeders and burners on the 10,000-sq.ft. auxiliary boiler

By W. F. MILLS
Power Superintendent
Ontario Refining Company, Ltd.

Waste-Heat Boilers Supply Steam to Copper Refinery

Six 6,500-sq.ft. waste-heat boilers on copper-melting furnaces and a pulverized-coal-fired auxiliary boiler supply steam at 175 lb. gage. Low-pressure steam for process and heating is obtained from a 2,500-kw. turbine exhausting against 10 lb. back pressure. Power for the electrolytic load is purchased and converted to direct current by three 2,000-kw. motor generators

AT COPPER CLIFF in the Sudbury district of Ontario, the Ontario Refining Company, Ltd., owned by the International Nickel Company of Canada, Ltd., The American Metal Co., Ltd., and Consolidated Mining & Smelting Company of Canada, Ltd., has put into operation the largest copper refinery in the British Empire. In the processes large quantities of steam at different pressures are required for heating electrolyte, for evaporators for drying ovens, and for other purposes. The electrolytic processes require the buildings to be maintained at a fairly constant temperature at all times. This, combined with the long, cold winters where the plant is located, made the demands for low-pressure steam unusually large.

One of the problems to be solved in the design of the plant was how best to supply the large steam requirements. For the electrolytic refining processes a large block of power is needed at practically 100 per cent load factor. This was purchased at 30,000 volts from the International Nickel Company's hydro-electric system. It was desirable to provide an emergency source of power at the refinery so that if the outside source failed power would be available for lighting the buildings and for the essential operations to keep the plant in working condition. This required installing a steam-turbine-driven generator. Some of the pumps used in the refining processes have to give practically 100 per cent service; therefore it was decided that these should be steam-driven. For the generator and pump drives and in some processes high-pressure steam had to be provided. The steam turbine for the generator was selected of such a size that it, along with the steam-driven pumps, could supply a large part of the low-pressure steam for heating and for process.

To supply the steam a waste-heat boiler was installed on each of the six copper-melting furnaces. An auxiliary boiler was provided to supply steam when the waste-heat boilers cannot meet the demands. This boiler was placed at one end of the cathode-storage building between the three waste-heat boilers on the anode-melting furnaces and those on the wire-bar-melting furnaces. Space was available at this location for the auxiliary boiler and a second unit if the latter is ever required. Placing the auxiliary boiler here brought it close to the other boilers and the main steam header. The fuel for the auxiliary boiler and melting furnaces was also concentrated in the same group of buildings, all being fired with pulverized coal.

It was desirable to keep the fuel-handling and preparation plant as far as possible from the processes.

To this end a central pulverized-coal plant was installed away from the other building. Coal is received by rail and the cars enter a shed adjacent to the pulverizing-coal plant. This shed has a capacity of five 70-ton cars and is heated in the winter. In severe winter weather the cars are placed in the shed and thawed to expedite unloading. Coal from the cars is dumped into a track hopper and taken by a pan conveyor to a crusher, from which it is delivered to a 50-ton raw-coal bin at the top of the pulverizing plant.

Before being pulverized the coal passes through a rotary-type, pulverized-coal-fired dryer. The gases from the heating furnace first pass around the outside of and then through the dryer counter to the coal's flow. The fine coal picked up by the gases is removed in a cyclone and returned to the dry-coal transport system and the gases go to the stack. The dry coal is stored in two cone-shaped bins from where it is fed to two pulverizers, each of 6 tons per hour capacity. From the mills the coal goes through cyclones and to the two weighing bins and is pumped by an air-transport system to the storage bins at the various heating furnaces, the auxiliary boiler and the drying furnace.

The coal is transported a maximum distance of 1,300 ft. in an overhead line. The coal line, the heating-steam line to the pulverizing plant and the compressed-air line for the transport system are insulated under the same covering. By doing this the steam line acts as a heater for the pulverized-coal line in cold weather.

The coal is weighed to each department in the plant and a record is kept by the pulverized-coal plant operator. The valves to the bins on the transport system are air-electric operated. The system is so arranged that when the first bin is full the valve automatically closes and the coal is delivered to the next bin. When this bin fills the coal automatically passes to the next bin. This sequence continues until all the bins are filled. When the last bin is full the transport system shuts down automatically.

On a panelboard in the pulverized-coal plant there is a miniature of the transport system showing the location of each valve. The positions of the valves are indicated to the operator by red and green lights. Push-button switches give the operator control of the valves, except when a bin is full, at which time the valve on that bin closes automatically and remains closed until storage space is available. By this arrangement the responsibility of weighing, distributing and recording the weight of coal to each user is in the hands of one man.

The equipment in the pulverized-coal plant and all steelwork is aluminum painted so that any coal dust can be readily detected. A central vacuum-cleaning system has been installed with outlets conveniently located about the plant. The plant is vacuum cleaned each day and its condition is proof that a pulverized-coal plant can be made just as clean as any part of a power station.

Above each of the six refining furnaces, three in the wire-bar-casting building and three in the anode-casting building, is installed a 6,500-sq.ft. waste-heat Stirling-type boiler. These boilers are of standard design except that they have a row of slagging tubes in front of the first pass. They are designed for 175-lb. gage pressure and have economizers and superheaters, the latter to give 110 deg. F. superheat. The boilers are equipped with soot blowers and the tubes are blown off twice each 8-hr. shift. The tubes are also steam lanced once each 8-hr. shift, which is necessary to prevent the metallic dust from the furnaces slagging on them. In the design of these boilers thermal efficiency was not a consideration, and they were built with large tubes arranged with standard spacing so as to interfere as little as possible with the operation of the refining furnaces.

The gases from the furnaces cannot be bypassed

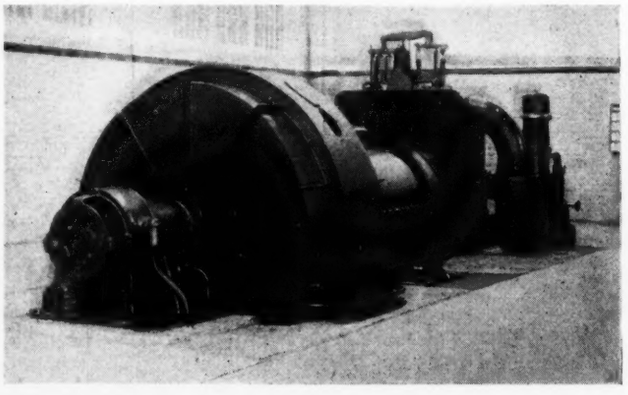


Fig. 1 (Above)—A 2,500-kw. steam-turbine generator is the chief source of low-pressure steam. The turbine supplies all the power above the amount of the purchased-power contract

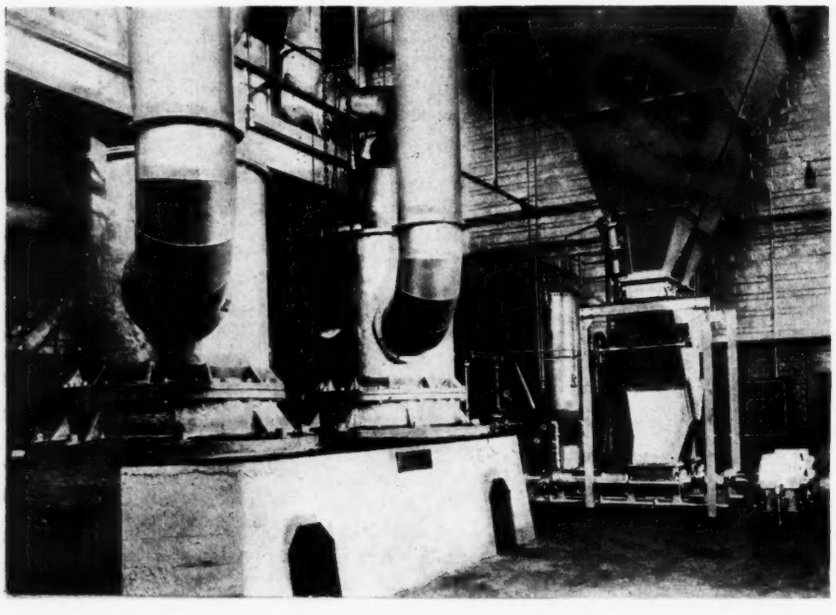


Fig. 2 (Left) — The two coal pulverizers in the central pulverizing plant are shown in the left foreground. In the background is the pump for the pulverized-coal air transport system. The coal is transported a maximum distance of 1,300 ft. in an overhead line

around the boilers to the stacks. In case of a boiler-tube failure the uptake from the furnace to the boiler can be plugged with a refractory slab to allow temporary repairs. The boilers are permitted to make all the steam they can, any excess above that required for the different services being blown to atmosphere through the safety valves. During the 14-hr. melting period for a furnace its boiler will supply from 30,000 to 40,000 lb. of steam per hour. This is a steaming rate equivalent to above 150 to 200 per cent of the boiler's normal rating. When refining the charge in the furnace the steaming rate of the boiler drops to about 7,000 to 8,000 lb. per hour. Except during casting periods, the waste-heat boilers supply sufficient steam for the plant under present part-

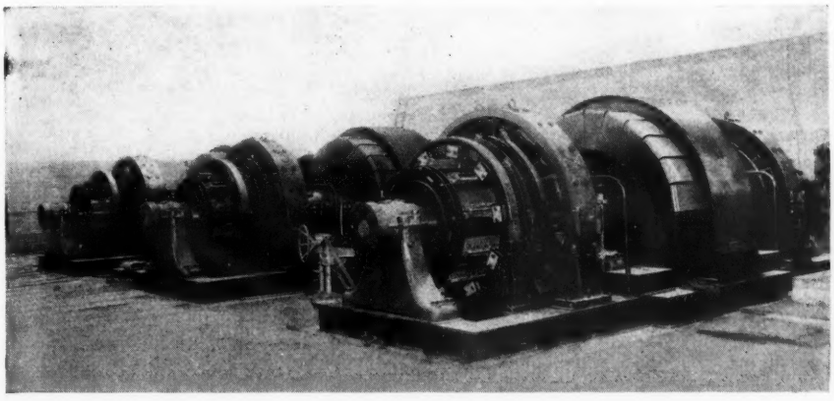


Fig. 3 (Above)—Three motor-generator sets supply direct current to the electrolytic copper-refining tanks. Each set consists of a 2,880-hp. synchronous motor driving two 6,000-amp. 80- to 160-volt direct-current generators

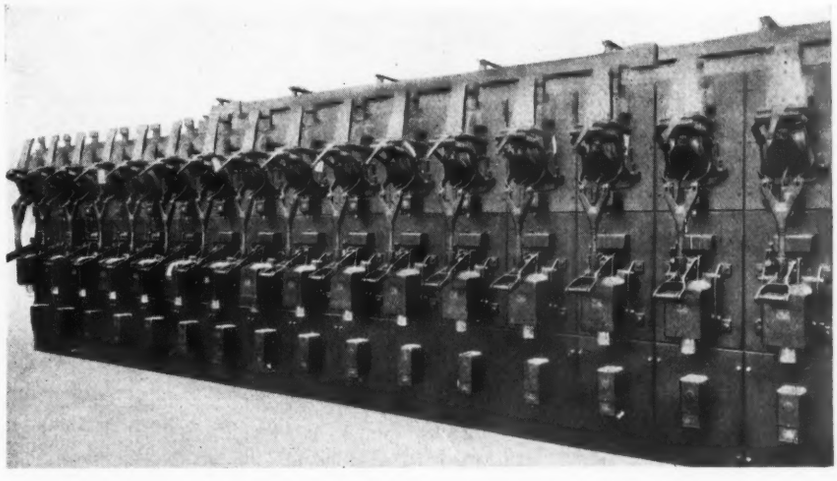


Fig. 4 (Right)—Circuit-breaker panelboard for the electrolytic-refining motor-generator sets. On these panels are twenty 10,000-amp. circuit breakers

capacity operation. With all six furnaces in operation the auxiliary boiler will rarely be required except for emergency.

The steam from the waste-heat boilers goes into a loop header. On one side of this header between the two rows of waste-heat boilers is the 10,000 sq.ft. auxiliary boiler, which supplies steam of the same quality as those using waste heat. It is of the same type except there are no slagging tubes in front of the first pass. This boiler is set over a refractory furnace without any provision for cooling the walls, and is fired by two horizontal-type pulverized-coal burners set on the same horizontal line. Below the furnace is a refractory ash hopper without a water screen, from where the ashes drop into a car for removal.

Coal for firing is supplied from the central pulverizer plant to a 50-ton storage bin above the coal feeders. There are three fans on the boiler, primary-air, secondary-air and induced-draft. Up to 50,000 lb. of steam per hour the primary-air fan can supply all the air necessary for good combustion. When the load exceeds this the secondary-air fan is started. This fan connects by a duct directly to the burners and is driven by a squirrel-cage motor at constant speed. The secondary-air control is by a damper, as is the primary-air. The induced-draft fan is driven by a wound-rotor motor and its speed is regulated by secondary-resistance control. All fuel and air control to the boiler is by manual regulation.

A fuel-oil supply is provided for the auxiliary boiler and a burner is installed in the furnace. The fuel nozzles are attached to flexible connections and are removed from the furnace when not in use. This burner can operate the boiler up to about 60 per cent of normal rating and is intended as an extra fire protection should all other sources of power and steam to the fire pumps fail.

The boiler operator is provide with a steam-flow, air-flow, meter, indicating and recording draft gages and feed-water flow and temperature recorders, and he regulates the combustion to maintain about 13 per cent CO_2. By doing this the boiler can be operated to 250 per cent of rating without seriously punishing the refractories. This boiler is equipped with soot blowers and the tubes are blown off one each 8-hr. shift.

A deaërating heater with a capacity of 200,000 lb. per hr. supplies feed water to the economizers on the boilers at 225 deg. F. Make-up feed water is supplied through a treating plant, where it is filtered and chemically treated.

Three combination boiler-feed and hydraulic-pressure pumps are provided. Two are turbine-driven and one is motor-driven. The turbine-driven pumps are normally used, one on boiler-feed and the other on hydraulic-pressure service, the motor-driven pump being a spare. The pumps are so connected that any of them may be used on boiler-feed service or on hydraulic service.

The turbine-driven pumps are equipped with pressure governors and are adjusted to maintain about 190 lb. pressure on boiler feed and 250 lb. pressure for hydraulic service. These pumps are interchanged from boiler-feed to hydraulic service every two weeks, to

PRINCIPAL POWER AND STEAM EQUIPMENT

Name of Company.....Ontario Refining Co., Ltd.
Plant location .....Copper Cliff, Ont.
Kind of plant, electrolytic copper refinery.
Designing engineers....Eng. Dept., U. S. Metals Refining Co.
Consulting engineers on power equipment,
E. Y. Sayer Eng. Corp.
Constructed by .....Fraser-Brace Eng. Co., Ltd.

Boilers, Superheaters and Economizers

Manufacturer boilers.....B.-W. & Goldie-McCulloch, Ltd.
Number, waste heat, 6; Stirling type with one row of slagging tubes.
Heating surface, sq.ft. 6,500
Pressure, lb. per sq.in., gage.....175
Manufacturer superheaters..B.-W. & Goldie-McCulloch, Ltd.
Type, double-loop, 3-pass; heating surfaces sq.ft.....1,100
Superheat deg. F. at 200 per cent rating.....110
Manufacturer economizers..B.-W. & Goldie-McCulloch, Ltd.
Heating surface, sq.ft. 4,000
Temperature of feed water deg. F. entering 220, leaving 270
Auxiliary boilers, number, 1; Stirling type.
Heating surface, sq.ft. 10,000
Superheater, type, double-loop, 3-pass; heating surface, sq.ft. 1,187
Superheat deg. F. at 200 per cent rating.....110
Economizer; type, hair-pin return-bend; heating surface, sq.ft. 4,000
Fuel, pulverized coal, from central pulverizing plant.
Capacity of coal-storage bin, tons 50
Feeders, two; type, Bailey..B. W. & Goldie-McCulloch, Ltd.
Drive, English Electric Co., 2-hp. d-c. motor.
Motor generators for direct-current supply to feeder motors on 6 refining furnaces and auxiliary boiler, number, 2; capacity, each 28 kw.; d-c. voltage.....230
Auxiliary Boiler:
Primary-air fans .....Sheldon, Ltd.
Drive, 25-hp. 550-volt, 1,500-r.p.m. English Electric Co., squirrel-cage motor.
Secondary-air fan .....Sheldon, Ltd.
Secondary-air control, manual damper.
Fan drive, 30-hp., 1,000 r.p.m. English Electric Co., squirrel-cage motor.
Pulverized coal burners, number, 2, type Bailey horizontal.
Manufacturer .....B.-W. & Goldie-McCulloch, Ltd.
Operate boiler up to 300 per cent rating, normally, not above 250 per cent.
Oil burner .....W. N. Best Corp.
Furnace walls, refractory without water walls or air cooling. No water screen.
Induced-draft fan .....Sheldon, Ltd.
Drive, 75-hp. 500-r.p.m. English Electric Co., Wound-rotor motor with secondary-resistance speed control.
Waste Heat Boilers:
Primary-air fans .....Sheldon, Ltd.
Drive, 10-hp. 550-volt English Electric Co. wound-rotor motors with secondary-resistance speed regulation.
Secondary-air fans .....Sheldon, Ltd.
Drive, 10-hp. 550-volt English Electric Co. wound-rotor motor with secondary-resistance speed regulation.
Induced-draft fans .....Sheldon, Ltd.
Drive, 40 hp. English Electric Co. wound-rotor motor with secondary-resistance speed regulation.
Stacks and breechings .....B.-W. & Goldie-McCulloch, Ltd.
Water columns .....B.-W. & Goldie-McCulloch, Ltd.
Feed-water regulators, Copes.....Northern Equipment Co.
Soot blowers .....Diamond Power Specialty Corp.
Blowoff valves .....Yarnall-Waring Co.
Safety valves .....B.-W. & Goldie-McCulloch, Ltd.
Non-return valves .....B.-W. & Goldie-McCulloch, Ltd.
Heat insulation .....Canadian Johns-Manville Co.
Feed-water treatment .....Permutit of Canada, Ltd.
Walks and gratings .....Canadian Bridge Co., Ltd.

Pulverized Coal Plant

Manufacturer .....B.-W. & Goldie-McCulloch, Ltd.
Capacity, pulverized coal, tons per hour.....12
Type of dryer, rotary, pulverized-coal fired.
Drive 25-hp., English Electric, wound-rotor motor.
Reduction gear, 36 to 1...Hamilton Gear & Machine Co., Ltd.
Control, secondary resistance, Canadian General Electric Co., Ltd.
Pulverizers, number 2; capacity, each tons per hour, 6
Coal transport, type Fuller-Kenyon, number 2, capacity tons per hr., each, 30.
Drive, English Electric Company squirrel-cage motors.
Coal scale .....Fairbanks, Morse & Co.
Vacuum cleaner .....Spencer Vacuum Cleaner Co.

Raw-Coal-Handling Equipment

Capacity, tons per hr. 50
Pan feeder conveyor .....Link-Belt, Ltd.
Drive, from coal crusher with multiple V-belt.
Coal crusher .....Link-Belt, Ltd.
Drive, English Electric Co., 25-hp. squirrel-cage motor.
Conveyor, bucket .....Link-Belt, Ltd.
Drive, English Electric Co....7.5-hp. squirrel-cage motor.
Coal bunker, 50 tons.....B.-W. & Goldie-McCulloch, Ltd.

Feed-Water Heater

Manufacturer .....Worthington Pump & Machinery Corp.
Type, deaërating, pressure 1 to 5 lb. gage.
Capacity, 200,000 lb. per hr., from 85 to 220 deg. F.

Boiler-Feed and Hydraulic-Press Pumps

Manufacturer .....B.-W. & Goldie-McCulloch, Ltd.
Number 3; stages 3; speed, 2,900 r.p.m.
Drive, two Waite steam turbine; one, motor.
Manufacturer of turbines....B.-W. & Goldie-McCulloch, Ltd.
Horsepower 64
Capacity of pumps, 300 U. S. g.p.m.; head, 520 ft.
Pump governors .....Fisher Governor Co.
Motor, English Electric Co., 75-hp. squirrel cage.

Turbine-Generator

Manufacturer of turbine.....Westinghouse Elec. & Mfg. Co.
Number, 1; capacity, 2,500 kw.; speed, 3,650 r.p.m.
Steam condition 150 lb. gage, 500 deg. F.
Back pressure, lb. gage, 10.
Desuperheater .....Schutte & Koerting Co.
Desuperheater control .....Swartwout Co.
Generator, 2,500 kva., 1.00 p.f., 3-phase, 2,300 volts.
Generator drive, gear, speed, 1,500 r.p.m.
Exciter, direct connected, 18 kw., 125 volts.
Generator, and distribution switchboard, Westinghouse Elec. & Mfg. Co.
Storage battery for emergency lighting, 160 amp.-hr., Electric Storage Battery Co., Ltd.
Battery, charging set, 2 kw..Canadian General Elec. Co., Ltd.
Oil centrifuge .....Sharples Specialties Co.
Travelling crane, 20 tons capacity.....Herbert Morris, Inc.

Motor-Generator Sets

Manufacturer.....Canadian General Elec. Co., Ltd.
Number, 3, supply electrolytic refining tanks.
Motors, synchronous, 2,880 hp., 2,300 volts, 500 r.p.m.
Generators, direct current, two on each motor.
Rating, each 6,000 ampere, 80 to 160 volts.
Exciter, direct connected, 30 kw., 125 volts, provides excitation for the motor and the generators.
Incoming-power and motor-control switchboard, Canadian General Elec. Co., Ltd.
Circuit breaker on d.-c. switchboard, Canadian General Elec. Co., Ltd.
Number, 20, rating amperes.....10,000

Power House Ventilation

Fan; number, 2, No. 60, Charavay...F. M. Webber Co., Inc.
Drive, 10 hp., 1,500 r.p.m. direct-connected squirrel-cage Robbins & Myers motors.
Air filters, Midwest.....American Air Filter Co.

Steam-Driven Pumps

Fire pump .....B.-W. & Goldie-McCulloch, Ltd.
Type, centrifugal, 4-stage, 1,000 g.p.m., 100 lb. pressure.
Drive, Waite steam turbine..B.-W. & Goldie-McCulloch, Ltd.
Skewback and mould-press pumps, 2, B.-W. & Goldie-McCulloch, Ltd.
Drive, Waite steam turbines, B.-W. & Goldie-McCulloch, Ltd.
Wash water, 2 .....B.-W. & Goldie-McCulloch, Ltd.
Drive, Waite steam turbines, B.-W. & Goldie-McCulloch, Ltd.
Vacuum pumps, 4.....Worthington Pump & Machinery Corp.
Drive, direct-acting, piston-valve.
Duplex oil pumps, 4.....Fairbanks, Morse & Co.

Air Compressors

Number 6
5 .....B.-W. & Goldie-McCulloch, Ltd.
1 .....Canadian Ingersoll-Rand Co., Ltd.
Capacity, five, 500 cu.-ft. and one 1,200 cu.ft. per min.
Air compressor on coal transport system, B.-W. & Goldie-McCulloch, Ltd.
Number, one 500 cu.ft. per min.

Valves and Traps

Reducing, low pressure .....Crane, Ltd.
Reducing, low pressure.....Mason Regulator Co.
Reducing, high pressure.....Crane, Ltd.
Reducing, high pressure .....Mason Regulator Co.
High pressure .....Crane, Ltd.
Low pressure .....Crane, Ltd.
Atmospheric relief .....Cochrane Corp.
Traps, high pressure .....Armstrong Machine Works
Traps, low pressure.....Armstrong Machine Works

Meters and Instruments

Boiler feed water .....Bailey Meter Co., Ltd.
Flow meters, steam.....Bailey Meter Co., Ltd.
Steam-flow, air-flow meters .....Bailey Meter Co., Ltd.
Draft gages, indicating.....Bailey Meter Co., Ltd.
Draft gages, recording.....Bailey Meter Co., Ltd.
Pressure gages, steam, indicating, J. Morrison Brass Mfg. Co.
Pressure gages, steam, recording.....Bristol Co.
Recording thermometers .....Bristol Co.
Vacuum gages ....Consolidated Ashcroft, Hancock Co., Inc.

Transformers and Oil Switches

Main power transformers, four 6,000-kva. 30,000 to 2,300 volts, Canadian General Electric Co., Ltd.
Three 400 kva., 2,300 to 550 volts; three 100 kva., 2,300 to 220 volts; three 50 kva., 2,300 to 230 and 115 volts; two 25 kva., 2,300 to 115 volts; three 350 kva., 2,300 to 550 volts; three 75 kva., 2,300 to 220 volts; three 25 kva., 2,300 to 230 and 115 volts. Ferranti Electric, Ltd.
Three 100 kva., 2,300 to 550 volts; three 150 kva., 2,300 to 550 volts; three 150 kva., 2,300 to 550 volts, English Electric Co. of Canada, Ltd. Oil switches in high-voltage outdoor substation, Canadian General Electric Co., Ltd.
Low-voltage oil switches, 2,300 volts and less, Canadian General Electric Co., Ltd., and Canadian Westinghouse Co., Ltd.

equalize the wear on the equipment, as hydraulic-pressure service is more severe than boiler-feed operation.

The skewback and mold-pressure pumps are also steam-turbine-driven, as is a fire pump located in the Bosh cooling-water pump house over 600 ft. away from the plant. Other steam-turbine-driven pumps are wash-water pumps in the tank house, vacuum pumps in the tank house and the duplex pumps on the oil service for the various oil-burning furnaces in the plant.

Because of these turbine-driven pumps being located in widely separated parts of the plant, and high-pressure steam being used in some of the processes, the high-pressure steam distribution system is about as extensive as is the low-pressure. In some parts of the plant where high-pressure steam is required the low-pressure heating steam is taken directly from the high-pressure main through a 150- to 10-lb. reducing valve. In this way the cost of running a low-pressure line to that part of the plant has been saved. To some of the outlying buildings the high-pressure steam is reduced to 50 lb. through a reducing valve for transmission and then to 10 lb. in the building to be heated. Reducing the pressure to 50 lb. allows using standard low-pressure pipe and fittings, at the same time insuring sufficient pressure at the outer end of the line for the heating system.

The main source of low-pressure steam is a geared turbine driving a 2,500-kva., 1.00 power-factor generator in the power house. This turbine supplies all the load above the amount of power contracted for and exhausts against a back pressure of 10 lb. gage. It is arranged to be governed by either load or back pressure. Any deficiency in low-pressure steam is supplied by a bypass around the turbine from the high- to the low-pressure main. In this bypass are two reducing valves and a desuperheater. One of these reducing valves bypasses all the steam up to 10,000 lb. per hour. When this amount is exceeded the second valve comes into service automatically. In general, the large valve is used only when the turbine is shut down.

The turbine-driven generator connects to the busbars on the switchboard from which the lighting and power loads about the plant are supplied, and normally serves these loads. There is a tie switch between this bus and that to which purchased power is supplied. Normally the two power sources are connected in parallel and part of the lighting and power load carried on purchased power, whenever there is an excess above that required for the electrolytic load.

Power is purchased at 30,000 volts and is stepped down to 2,300 volts through a bank of three 6,000-kva. transformers connected delta-delta. The transformers are out of doors and are of the self-cooled type. A spare is provided, and all four transformers are connected on the primary and on the secondary to double-throw disconnect switches, Fig. 5, so that the spare can readily be switched in to replace any one of the transformers in the bank. The double-throw switch on the spare transformer will also allow connecting to the transformers in a second bank when they are installed.

From the transformers the 2,300-volt power goes to the busbars for the motors on the three-generator sets supplying the electrolytic load. Each of these sets consists of a 2,880-hp. synchronous motor driving two 6,000-amp., 80-to-160-volt generators at 500 r.p.m. An exciter directly connected to one end of the set's shaft supplies exciting current to the fields of the motor and the generators. Rheostats in the field of all four machines allow of collective and individual adjustments of the field currents.

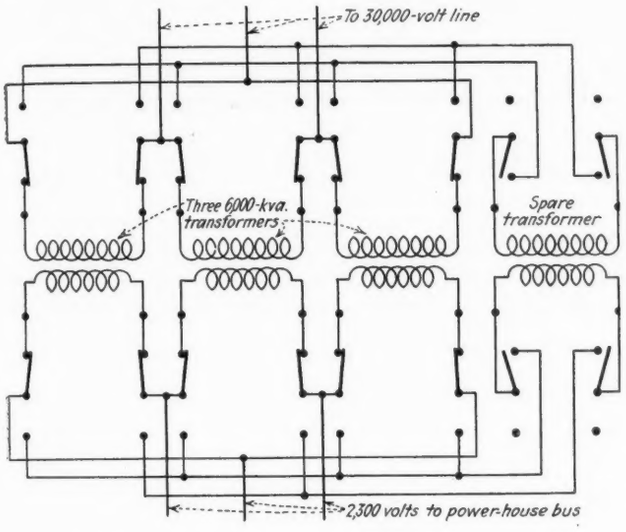


Fig. 5—Diagram of the transformers and their switch connections

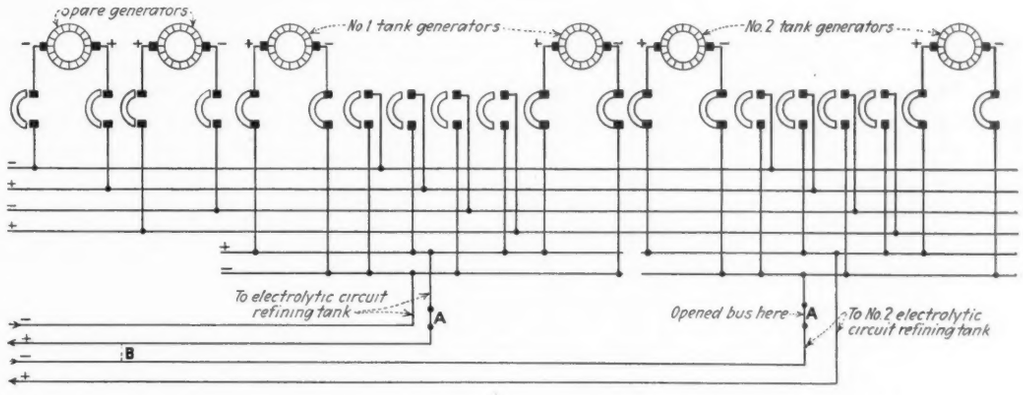


Fig. 6—Diagram of the direct-current generators connected to the electrolytic-refining-tank circuits

On the purchased-power switchboard there are two sets of busbars, one for the 2,300-volt incoming power and the other a reduced-voltage bus for starting the motors. Reduced voltage for starting is provided by two three-phase auto-transformers, either of which may be connected between the full-voltage and the reduced-voltage buses by switches.

Each of two of the motor-generators supply an electrolytic copper-refining tank circuit. The two 6,000-amp. generators in each set are connected in parallel on a busbar to which the tank circuit connects as in Fig. 6. The two generators of the third set, which is the spare, are each connected to a separate bus and either or both may be connected to either tank bus; or one generator may be connected to No. 1 tank bus and the other to No. 2 tank bus. This makes a very flexible combination to meet any requirements of the electrolytic process.

The wide range of voltage control, 80 to 160 volts, provides for a current adjustment to any desired value. By opening the tank circuits at *A* and connecting them at *B* the two tanks can be put in series for a long deposition of the copper.

Air for ventilating the turbine-generator and the motor generators is supplied through a large louvered intake built in the yard in front of the plant. The air is taken through oil-cleaned movable filters and is delivered by a fan into the plant's basement. From here it is taken up through the machine by fans on their rotating members and discharged into the generator room, passing outside the plant through louveres in the roof.

Power, steam, air and fuel are metered to each service, and each department is charged for what it uses. Water to the different departments is not metered, since its cost is so low that metering is not justified. The meters are read daily, and reports compiled from these readings are compared with the records of the previous day and the same day of the previous month.

Any unusual changes in the daily meter readings are investigated to find the cause. Semi-monthly and monthly reports are compiled from the daily records and an accounting is rendered to the department heads each month. The plant is run under practically test conditions at all times and is so metered that any change from normal operation is readily detected and corrected.

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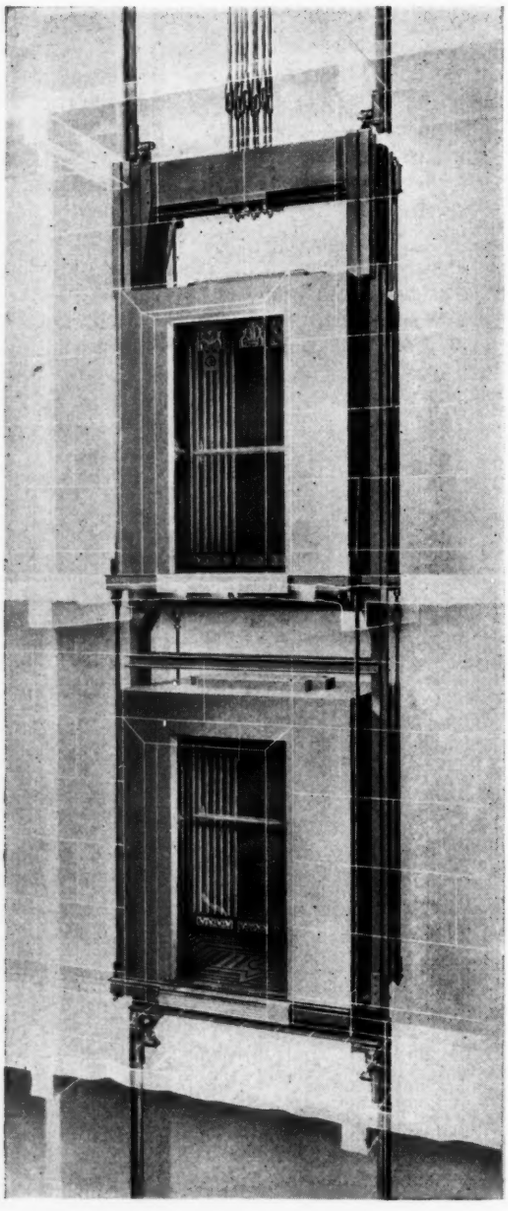

Phantom view of first double-deck elevators being installed in the Cities Service Building

Cities Service Building Has Double-Deck Elevators

FOR the first time in the history of building construction double-deck elevators have been installed in a skyscraper. The building is the new 67-story home of the Henry L. Doherty and Cities Service Companies at Cedar, Pine and Pearl Streets in New York's downtown financial district. This forward step in vertical transportation, now permitted by special provision in the new elevator code, has long been awaited by the industry to help solve the problem of tall-building economics.

The strict zoning laws in New York and other large cities often reduce tower areas to such an extent that one of two equally undesirable alternatives result: either the elevators require so much floor area that adequate rentable space cannot be obtained on the tower floors, or the number of elevators is reduced at the expense of good service. It had long been felt by architects and engineers that increasing the handling capacity of an elevator hoistway is the only means out of the difficulty. Experiments with double-deck elevators have been in progress for several years, simultaneously with the movement to have the code revised to permit that type of installation.

In the Cities Service Building eight high-rise, double-deck Otis elevators will serve all floors from the 29th to the 63rd, the intermediate floors being served by seven cars running from the 16th to the 29th, and the lower floors by eight others. In addition, another innovation in office-building transportation has been installed—escalators to handle the rush-hour traffic between the sixth floor and the basement.

The double-deck elevator consists of two separate compartments mounted in a single car frame, or, more simply, a two-story car. It is driven by a single hoisting machine and controlled basically in the same manner as the standard signal-control elevator. Both compartments are loaded at the same time, one from the ground floor, and the upper one from the first floor. Passengers are discharged at the upper floors at the same time, one compartment serving only odd-numbered floors, and the other the alternate floors.

Each compartment has a capacity of 2,500 lb., is equipped with the standard signal-control operating devices and has an attendant. Trap doors are provided to permit emergency access between compartments, and

speaking tubes allow communication between them. Dur- the night, when transportation requirements are small, a single remote-control switch will permit operation as single-deck cars. At such times, all operating devices are effective from one compartment only.

Special operating devices were equipped to coordinate the starting and stopping movements of the two cars. The elevator will start only when the operating handles of both compartments are in the full-start position and all car and hoistway doors are closed. By the same automatic devices which stop single-deck cars at floor level, the floors of both cabs will stop level with the desired floors in the double-deck system. The doors of both cabs will not open, however, unless calls have been registered for both floors at which the car stops. For instance, if the button for the 48th floor has been pushed, and the button for the 49th floor has not, only the door of the lower cab will open when the car stops at these levels.

If, however, the hall button for the 49th floor is pushed before the operating handle in the lower compartment has been set in the full start postion, the hall light on the 49th floor will light immediately, and the doors of the upper compartment will open. If the start has been initiated before the button on the 49th floor has been pushed, the call will be transferred to the next elevator.

To keep the operators of each cab informed about the activities in the other cab, a door pilot light is provided in the operating box of each compartment. The light is illuminated when the doors of the other cars are open, and is extinguished when they start to close. The timing devices for these coordinating movements have been perfected to such an extent that there is no possibility of accident from open doors. As an additional precaution, a car safety switch has been installed in both compartments, operation of which immediately stops the elevator.

The frame supporting both compartments has an overall height of 25 ft. Any one of the eight special-steel traction hoisting ropes is more than capable of carrying the combined weight of both compartments. Clamp type car safeties, consisting of two sets of powerful rail-gripping jaws, are mounted at both the top and bottom of the car-safety frame.

Apart from the engineering achievement which has accomplished by the Otis Elevator Company in developing the double-deck elevator, the successful operation of the system in the Cities Service Building will have a marked influence upon tall-building design and construction. In this particular building, before the elevator code was revised it was deemed necessary to install fourteen single-deck elevators to serve the floors which will be served by the eight double-deck cars. When it is considered that each hoistway requires approximately 50 sq.ft. of space on every floor, and that fourteen would have to run from the ground floor to the top of the building, it will be seen what a tremendous saving of valuable floor space was afforded by the installation. Six less hoistways of 50 sq.ft. each in 60 stories result in a saving of 18,000 sq.ft. The probable increased revenue, on the current basis in the new buildings in the financial district, $3.50 per sq.ft., is $63,000.

What the effect of double-deck elevators will be upon growth in the height of buildings is not determinable, since so many other factors of economics enter into the decision. By this device, skyscrapers, much greater in height than our present buildings are now possible, for economic elevator service has heretofore been the chief deterrent in height extension.

The architects for the Cities Service Building were Clinton & Russell, and Holton & George. James Stewart & Company were the builders.

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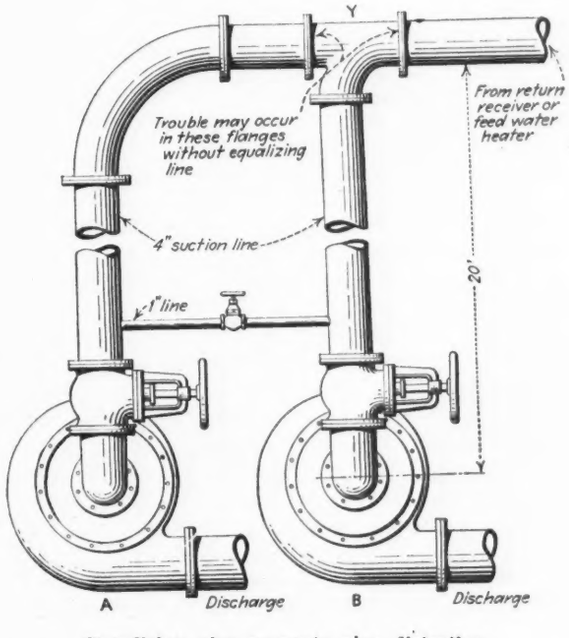
Expansion in Boiler-Feed Piping May Cause Trouble

BY H. M. SPRING

IN PIPING systems laid out similarly to that shown in the illustration, there may be considerable trouble with leaks at the "Y" connection. This will occur when one feed pump is run alone and the second kept for emergency service. It will be found that the water in the vertical suction line of the spare pump will be at but little above room temperature, while the other line will be at approximate feed-water temperature. Assuming the feed water to be 350 deg. F. and the room temperature 80 deg. F., the resulting expansion in the hot line will be (350—80) × 0.0000065 × the pipe length. If the distance is 20 ft. the resulting expansion will be over 0.4 in. This expansion will cause serious stresses in the flange joints of the "Y" connection.

A temperature-equalizing line connected between these two pump suction lines at their base usually will correct this trouble. This line should be ¾ in. for piping under 4 in. and should be 1 in. diameter for 4-in. or larger pipes. Due to the pressure differential in the two suction lines from the friction head plus the velocity head, a flow will result in this equalizing line sufficient to keep the dead line at nearly the same temperature as the active pump line. A globe valve in the equalizing line should be opened just enough to keep this line hot. By this arrangement the two vertical lines will expand very close to the same amount and the stresses on the overhead joints will be greatly reduced.



Equalizing pipe prevents pipe distortion

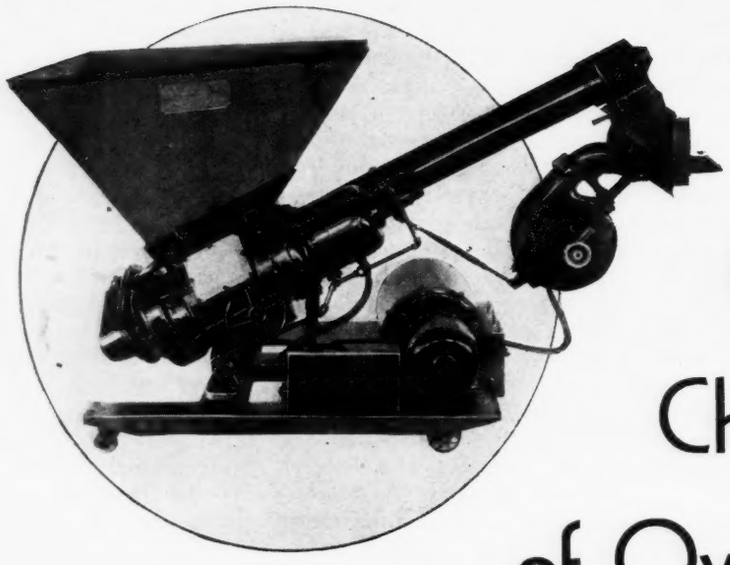


Fig. 1—Aerio track-mounted air-blast over-feed type stoker

Operating Characteristics of Overfeed Stokers

The wide range of mechanical stokers now available embodies widely differing characteristics. Several new units have recently entered the field and important refinements have been made to existing types. With a view to presenting the more important features of the present-day equipment a series of three articles has been prepared. In this first article only the overfeed type is described; subsequent articles will deal with underfeed and chain grates

CONTRARY to the general opinion held by some engineers a few years ago that the advancement being made by pulverized coal would adversely affect the development of mechanical stokers, the last five years have probably been one of the most important periods in the history of stoker development.

During this time not only have a number of new stokers been introduced, but important refinements have been made to existing types, until at the present time efficiencies being obtained with stokers approach or equal those being obtained under similar operating conditions with other methods of firing.

Although the larger number of new units introduced have been in sizes suitable for the smaller power and heating boilers, it is only comparatively recently that this size of installation has received its share of attention from the stoker designer. As a result of these recent additions, units are now available in power-operated types suitable for all coals and sizes and types of power and heating boilers having from 100 sq.ft. of heating surface up.

It is not the purpose to discuss here the relative merits of each type of stoker, but rather to acquaint the reader with the various types available and to point out some of the operating features of the various units comprising each type. In this article the different units in the overfeed class only will be considered.

Although no arbitrary ruling can be made as to the minimum size of boiler under which a mechanical stoker can be economically installed or the minimum size of plant that can be economically so equipped, it is safe to assume that with the wide range of stokers now available few if any boilers are installed without stoker firing being given due consideration.

Before deciding upon a type of stoker for any given installation a survey should be made of the coals commercially available, bearing in mind that the kind offered at the lowest price is not necessarily the cheapest fuel. With the survey completed and an analysis made of the conditions under which the stoker will have to operate, it will not be difficult to choose a stoker that will fill the requirements.

Power-operated mechanical stokers are divided into three distinct classes, overfeed, underfeed and chain or traveling grates. The overfeed may be further classified as to natural or forced draft, front or side feed; as to the method of introducing the coal into the furnace, by air stream, revolving blades or pusher blocks; and as to the type of grate employed, as standard horizontal or inclined shaking grate, reciprocating or power-driven grate bars and special bars with directed air jets.

Although no definite line can be drawn as to the kinds of coal that should be used with each type of stoker, there is a range of fuels to which each type is par-

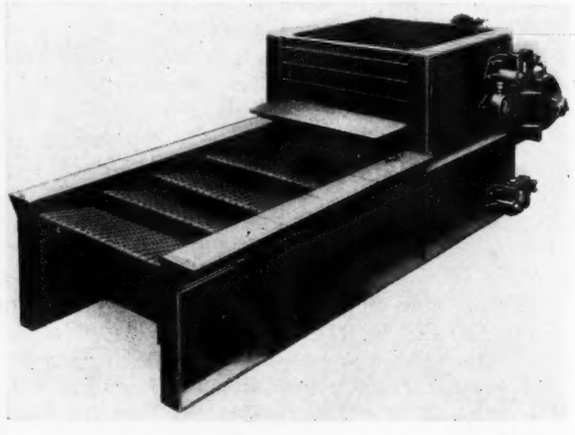
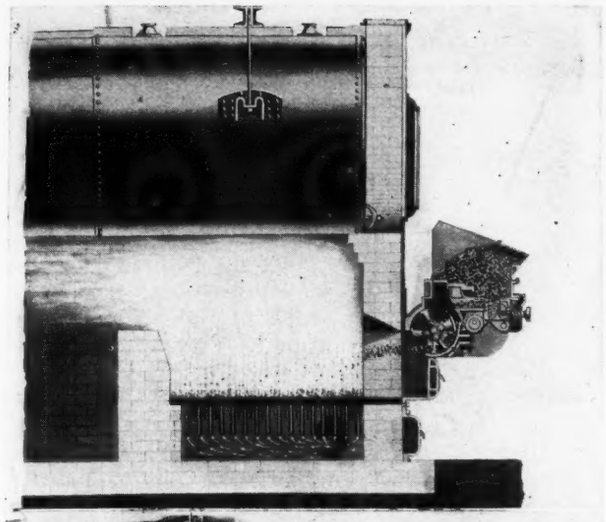


Fig. 2—Whiting horizontal compression stoker



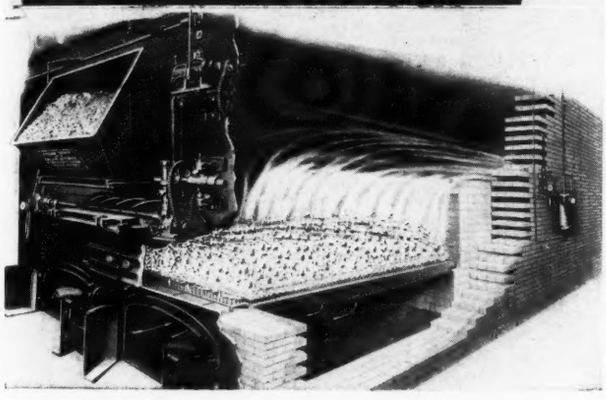


Fig. 3 (Top)—Firite stoker with angularly placed air jets in grate

Fig. 4 (Bottom)—Chicago automatic revolving-blade type unit

ticularly adapted. In general it may be said the overfeed type is best suited to the free-burning and low-volatile coking bituminous coals found in the Eastern states, which require some agitation of the fuel bed and are not particularly difficult to ignite. Some types of overfeeds can handle a much wider range of fuels than others, depending largely upon the amount of agitation that can be given to the fuel bed.

In units employing a revolving distributor and horizontal grate with forced draft but no agitation, the fuel bed thickness is limited to around 3 in., while with the inclined type of grate employing reciprocating or movable grate bars the fuel bed thickness can be increased to 6 in. or over. Certain types of overfeeds are also well suited to the burning of refuse fuels such as sawdust, hog fuel, etc.

A type of overfeed stoker designed to burn the smaller-sized coals from 1½ in. screening down is the truck-mounted unit, Fig. 1. The coal is conveyed from the hopper to an air-blast feeding head by a screw conveyor, motor-driven through a variable-speed reducer. From the conveyor the coal drops to a 45-deg. deflecting plate leading to a semi-circular grooved casting that guides the coal into the furnace under pressure of an air blast. In the furnace the fine particles burn in suspension and the larger particles settle and burn on a pin-hole grate provided with forced draft by a fan mounted directly on the truck with the other units.

Changing the stroke of a reciprocating feed plate regulates the amount of coal supplied to the furnace by the revolving distributor used on the unit shown in Fig. 3. The speed of the distributor is constant and the spread of the coal is controlled by the setting of a circular tray forming the lower section of the distributor housing. The grate surface is of special design. Air preheated to some extent by short tube extensions on the lower side of the grate is injected into the fuel bed through angularly placed openings, causing a criss-crossing of air jets within the fuel bed.

The raising or lowering of a wedge by a steam pressure regulator varies the stroke imparted to a pusher block in the unit, Fig. 4. The revolving distributor is essentially an adjustable reel loosely fitted with four rows of cast-iron blades. The reel is formed by four blade shafts spaced 90 deg. apart on a circle concentric to the main stoker shaft. Every other shaft has right-hand blades, and the alternate shafts have left-hand blades. On each shaft the angles of the blades vary so that each blade serves a particular area of the grate.

Maintaining a uniform fuel bed over the entire grate surface is one of the principal difficulties encountered with all types of stokers, especially where forced draft is employed. This difficulty is minimized, however, by proper preparation of the coal and by providing means to prevent segregation of the coarse and fine coal in the stoker hopper.

A unit designed especially to overcome this trouble by maintaining a compressed fuel bed is illustrated in Fig. 2. Two alternate movable grate sections having a reciprocating action slide on alternate stationary sections and push the fuel bed progressively toward the rear. The internal strength necessary in the fuel bed to overcome the frictional resistance of its weight on the grate surface tends to keep the fuel bed compressed in a compact mass of more or less uniform thickness. Natural or forced draft may be used. Although this unit has been grouped with the overfeeds, it is probably

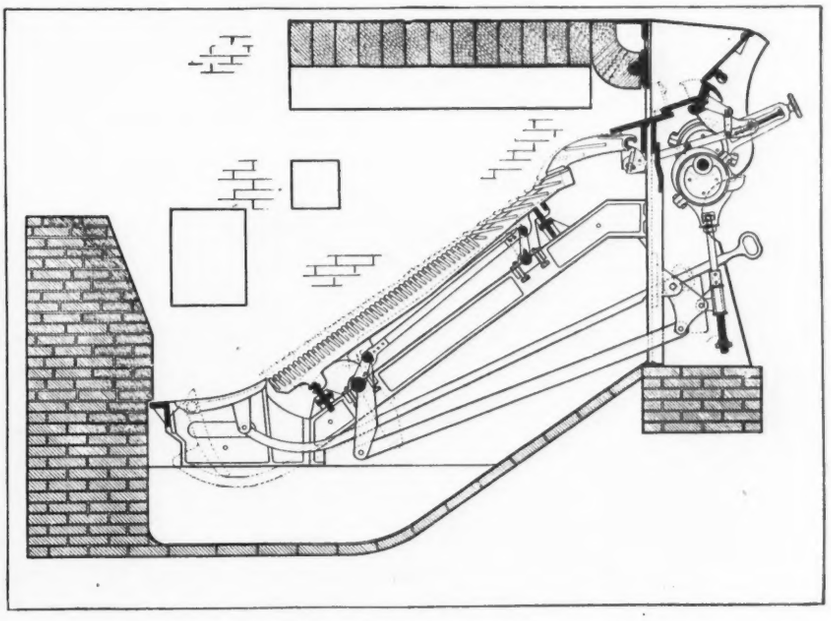


Fig. 5—Cross-section of Wetzel automatic mechanical stoker

OVERFEED STOKERS FOR HEATING, INDUSTRIAL AND POWER BOILERS

Type	Size B.H.S. Sq.Ft.	Drive	Feed	Draft	Grate	Manufacturer
Aerio	500-5,000	Electric	Air	Forced	Horizontal, shaking	Aerio Coal Burner Sales Corp.
Chicago	250-5,000	Electric	Revolving blades	Forced	Horizontal, shaking	Chicago Automatic Stoker Corp.
Pulverzone	500-2,000	Electric	Pusher block	Natural	Inclined, rocking	Cokal Stoker Corp.
Firite	700-6,000	Electric	Revolving blades	Forced	Horizontal, Air jet	Hoffman Combustion Engineering Corp.
Huber	500-5,000	Steam-Hyd.	Pusher block	Natural or Forced	Inclined, rocking	Flynn & Emrich Co.
Neemes	300-1,500	Electric	Pusher plates	Natural	Inclined, rocking	Neemes Foundry, Inc.
Perfection	300-2,000	Electric	Pusher blocks	Natural or forced	Inclined, rocking	Perfection Grate & Supply Co.
Murphy	1,000-3,000	Electric-Hydraulic	Pusher blocks	Natural	Inclined, V-type	Riley Stoker Corp.
Wetzel	700-5,000	Electric-Steam	Pusher plates	Natural	Inclined	Wetzel Mechanical Stoker Co.
Whiting	250-2,500	Electric	Pusher plates	Natural or forced	Horizontal	Joseph Harrington Co. (Whiting Corp.)

more correctly termed a horizontal compression stoker.

In the natural-draft unit, Fig. 5, the coal in passing from the hopper to the grate proper moves over a coking grate containing an unusually large percentage of air spaces. The grate proper, which is inclined at an angle of about 30 deg., comprises a series of movable and stationary grates, the amount of movement on alternate grate bars as well as the coking grate and pusher block being indicated by the dotted lines.

Another unit designed for natural-draft operation only employs steam jets above the fire to promote turbulence in the combustion chamber. The idea behind the use of the jets, in addition to increasing the turbulence, is to cause the fine particles to be burned in suspension. The jets are in operation only when the steam pressure is below normal,

Where a stoker must operate on a widely fluctuating load, or peaks must be met on short notice, forced draft is usually employed. Its use also permits of burning a wider range of fuels than is otherwise possible. The use of forced draft, however, calls for more careful attention on the part of the stoker operator, and if not properly handled may increase the stoker and refractory maintenance. The fuel bed must be watched more closely and care exercised to see that no holes are blown in the fire. The decrease in resistance to the passage of air offered by a small hole in the fire will rob the rest of the fuel bed of some of the air it should get and the fire will tend to burn thin surrounding the opening in the bed and become thicker in other parts.

In many industrial plants the load can be carried for a large share of the time under natural-draft conditions, forced draft being used only over peaks or periods of increased load during certain hours of the day.

Some stokers are designed to permit being readily changed from forced- to natural-draft operation by removal of doors on the front of the stoker. In Fig. 6 coal is fed by a pusher plate to a coking shelf, where it becomes ignited and partly coked before dropping to the fuel bed. Secondary air under control is supplied above the coal on the coking shelf, and also below the shelf, to assist in burning the volatile matter released from the fuel during the coking process. Alternate movement of the stoker bars, operated by the stoker mechanism in relation to the amount of coal being fed, agitates the fuel bed and works the ash and clinker toward the dump plate.

Multiple operation of the stoker bars and the employment of agitators to operate against the coked fuel and push it downward on the grate characterizes the unit shown in Fig. 8. The operations of the agitators and the grate bars are entirely separate from the stoker feed, so that their movement can be speeded up or slowed down as required by fuel bed conditions independently of the amount of coal being fed.

The side-feed V-type stoker, Fig. 7, is similar in many respects to the front-feed type and operating methods are essentially the same. Two inclined-grate surfaces face each other, forming a furnace of V cross-section. Stationary and movable grate bars run parallel with the fuel bed and the coal is caused to move slowly toward the bottom of the V by the action of the movable bars assisted by gravity, where the ashes and clinker are removed by a clinker grinder. A suspended or sprung arch forms the top of the furnace. With this stoker fuel bed thickness of 3 to 4 in. is recommended, but this varies somewhat with the kind of coal being used, the stack draft obtainable and the load carried.

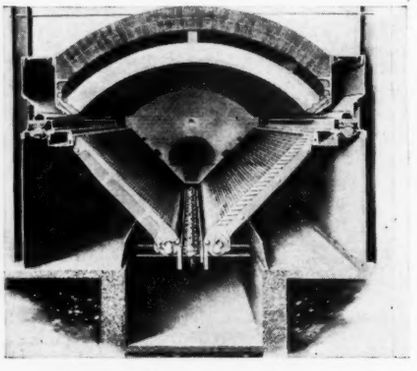
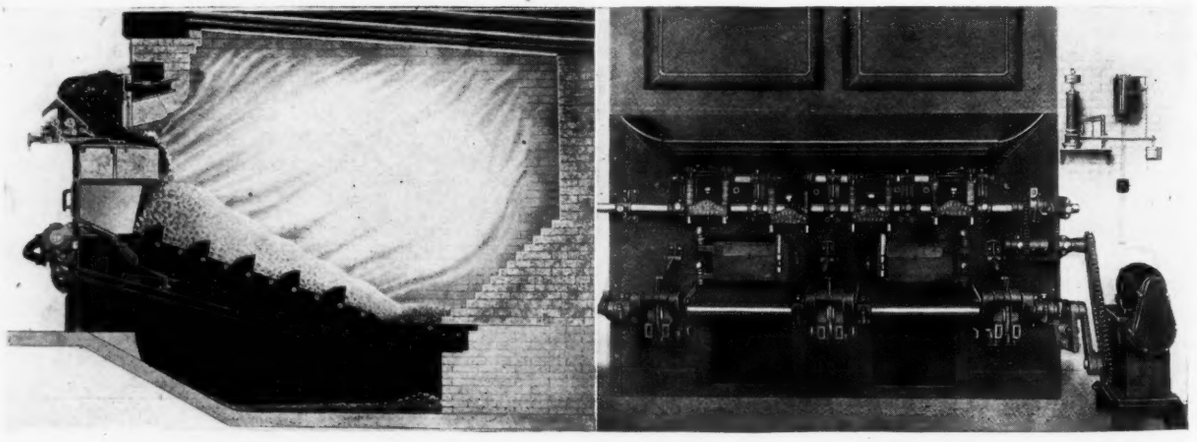
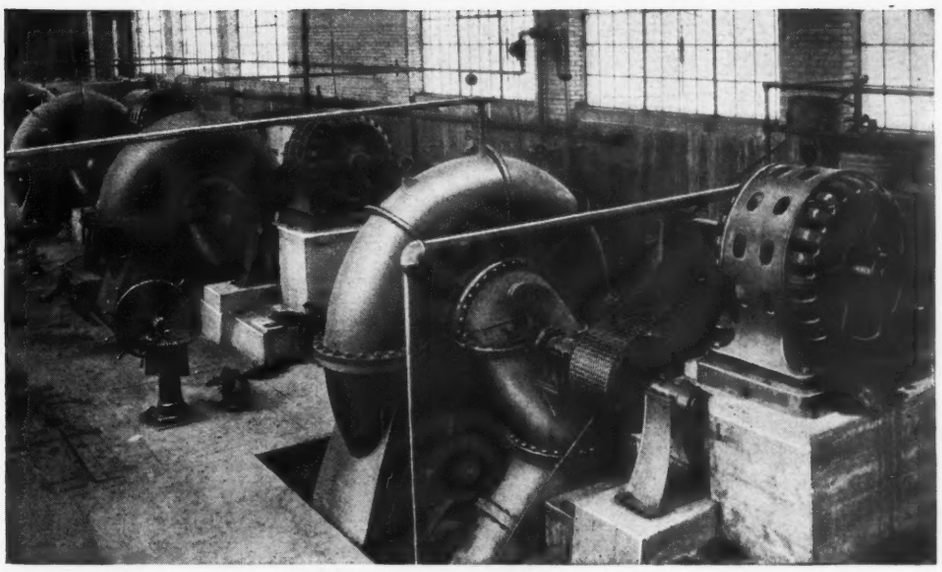


Fig. 6 — Huber stoker for forced or natural draft

Fig. 7—Murphy natural-draft side overfeed stoker

Fig. 8—Front view of Perfection overfeed unit





Low-head centrifugal pumps driven by squirrel-cage motors

By MARIN PHILLIPS

Selection and Operation of CENTRIFUGAL PUMPS

Instructions for their proper selection, installation and maintenance

SELECTION, installation and operation are factors that enter into the efficient and satisfactory operation of centrifugal pumps. Pumps must be carefully selected, taking into consideration the material to be pumped and operating conditions. The proper selection of pumps depends on a knowledge of operating conditions obtained by a wide experience in their applications, an experience that most operating men do not have a chance to acquire. The reliable pump manufacturer is usually better able to apply pumps than any one else. However, when pumps are chosen in this way it does not relieve the operating man of responsibility.

Select a pump manufacturer who has had experience in applying pumps to the intended services and who has such pumps in satisfactory operation. If this point is not closely watched, one is likely to obtain an experimental installation, in which case the plant stands to be the loser. Occasionally a new pumping application may develop for which there have not been sufficient installations accurately to apply a pump to the service. In such cases it will be to the plant's advantage to cooperate with the pump manufacturer in the application.

Power being a large item in many manufacturing costs, the efficiency of pumps is important. It is therefore necessary to know the amount of material to be delivered and the operating conditions, which often vary considerably. Generally speaking, the close-running, closed-impeller pump will be more efficient than the spaced, open impeller. But the material to be pumped will dictate the impeller's type. Where the material to be handled contains solids or abrasive foreign matter the less efficient open-type impeller pump may have to be selected. Also, where a breaking action of the materials is desired in the pump the open impeller will more than likely fit the application better than the closed type.

The next item to receive close attention in the pump's selection is its maintenance. High maintenance costs naturally mean high outage from service and increases in operating expense. The requirements for a pump of low maintenance and reliable operation is simplicity in design, substantial construction and with parts that experience has shown to give long service. The pump should not have complicated parts requiring very fine adjustments that the plant maintenance crew may not be equipped to make.

Many operating difficulties experienced in centrifugal pump operation can be traced to faulty installation. When a pump is directly connected to its prime mover it should be set on a baseplate, level in both directions and firmly attached to a solid foundation. It is not necessary to have a massive foundation, but it must be sufficiently solid to hold against vibration, weight of the pump and prime mover and piping. The foundations must be even and solid to support the pump's base properly at all points. If belt-driven a little more care will be required in constructing and anchoring the foundation to take care of the belt strain. Where it is desirable to have a dry floor around the pump, a curb 3x3 in., having a drain pipe in it, can be placed around the top of the foundation.

When bolting the baseplate to the foundation care must be exercised not to spring it by pulling it down unevenly.

If this is done it will throw the bearings out of alignment, resulting in undue friction, with loss of power and frequent replacement of bearings and packing. When aligning the prime mover to the pump a straight edge should be used as a means of ascertaining when the coupling faces are exactly in line, Fig. 1. Run the straight-edge all around the rim of the coupling. Where the coupling faces do not come together the distance between them should be the same for any position of the coupling, as determined by a gage, Fig. 2. When through aligning and the coupling bolts are tightened the prime mover and pump shafts must turn freely. The pump should not be placed on too green a foundation, but the concrete should have ample time to dry to prevent uneven settling of the base plate.

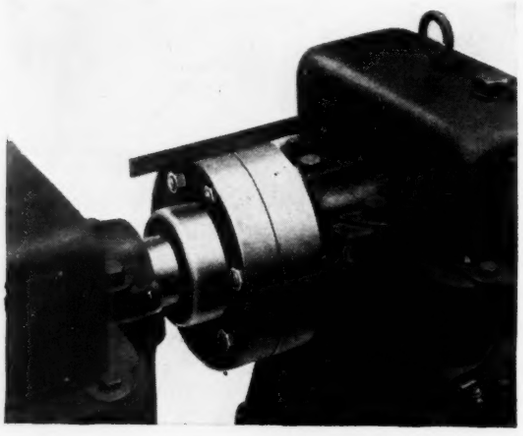


Fig. 1 (Left)—The two halves of the coupling should be checked for parallel alignment with a straight edge

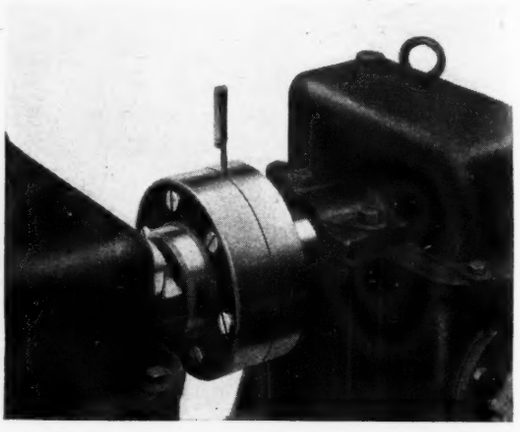


Fig. 2 (Right)—The space between the two halves of the coupling should be the same all around when checked with a gage

The pump should be placed as near as possible to the material to be handled. Suction lifts will vary with the size of the pump and the liquid handled. As it is difficult to pump hot water or heavy liquids, it will be necessary for them to flow to the pump under a positive head. The required head will vary with the temperature and viscosity of the liquid.

It is necessary that the suction line be airtight, for air in the casing will destroy the vacuum, resulting in no discharge. For efficient operation, air pockets in the suction and discharge lines must be avoided. If this is not done air will collect in them and decrease the effective area of the piping. Long-radius bends are preferable to short elbows in the suction and the discharge lines. To prevent air pockets in the suction line it should rise continuously from the supply to the pump.

Pipe smaller than the pump's flanges should never be used in the discharge line. If the line is long the piping should be one or more sizes larger than the pump's discharge. It will in some cases be advisable to place a check valve in the discharge line if it has considerable length. Place the gate valve and check valve as near the pump as possible, with the check valve between the gate valve and pump, so that the check valve may be required or inspected without emptying the discharge line. Suction and discharge lines must be well supported outside of the pump. Where the pump is allowed to support the weight of the piping, strains that sooner or later will give trouble will be placed on the pump's casing and connections.

Pumps having a suction lift, where no other means are provided for priming, should have a foot valve with a free area greater than that of the suction pipe. There is a possibility that water-hammer will develop in a pump fitted with a foot valve. For this reason some engineers recommend the installation of a check or a gate valve in the discharge line, priming being accomplished manually or by a power-operated vacuum pump. Priming is not so satisfactory and simple as the foot valve placed in the suction inlet, due to having to operate auxiliary equipment every time the suction line is empty. Where priming connections are made they should be attached to the highest point of the pump casing. A strainer should be provided on the suction pipe inlet to exclude foreign matter that might get under the foot valve and prevent its closing when the pump is shut down, thus allowing the water to run out of the suction pipe and pump casing. When all piping and installation work is completed recheck the alignment of the pump and see that it turns freely before starting operation.

When the pump is ready for operation, carefully clean the bearings with kerosene and fill them to the proper level with high-grade lubricating oil. Usually the pump will be shipped from the factory with the packing removed from the stuffing box. If it is not, the packing should be removed to permit free movement of the shaft while lining up the pump with prime mover. The stuffing box should be filled with packing made especially for the material being pumped. Care must be exercised when pulling up on the packing gland nuts not to get them too tight or excess friction will cause heating. At high speeds the packing may burn and score the shaft. Where a small leak of the material being pumped will not be objectionable the packing nuts can be tightened by hand at first. Then the packing can be tightened a little at a time as needed to stop the leak. It is well to remember that the packing may heat and expand when in operation. Where it is necessary in starting to have the packing tight enough to prevent leakage, it may be loosened a little after it has been in operation for a while.

Some pumps are fitted with wated-sealed stuffing boxes. The water seal may be taken from the discharge side of the pump or from a separate source. If the water being pumped contains grit or sand the sealing water must be supplied from a separate clean source.

Before starting the pump it must be primed to prevent injury to the interior parts, which depend on water for their lubrication. The pump must remain stationary while being primed, for under no conditions should it be operated without water in the casing. The pump is started with the discharge closed. As soon as it comes up to normal speed, open the valve in the discharge line gradually, until full load is reached. When starting a centrifugal pump with the discharge valve closed, there

will be less load on the motor than when the valve is open. A centrifugal pump may be operated with the discharge valve closed so long as the water and casing do not heat up excessively.

When the pump is put into operation note if there is vibration or overheated bearings. If vibration is present it is more than likely that the shaft has been sprung. When bearings heat up on a direct-connected unit it is an indication that the pump is not properly lined up. If the pump is belt-driven check the belt tension to see that it is not excessive. To assist the belt to carry the load, have the tight side on the bottom while in operation wherever possible. Also, keep the ratio of the driving and driven pulleys within the limits that have been established as good practice.

Pumps equipped with thrust bearings are generally subject to heavy end thrust. This requires that the thrust bearing be carefully adjusted to center the impeller in the casing. If this is not done the impeller will be drawn up against the casing or put end thrust on the prime mover's bearings, and may overload the prime mover. When the thrust bearing is once properly set it should be checked at frequent intervals to see that it maintains this position. If the shaft coupling is of the flexible type any end movement of the impeller can be detected by measuring the distance between the faces of the coupling. Any wear on the thrust bearing can also be checked by using a small bar, with the pump stationary, to see if there is any end play in the shaft.

The life of the pump and its satisfactory operation depends, like all other machinery, on its bearings. Worn and loose-fitting bearings cause an increase in power consumption and increased maintenance costs from scored and sprung shafts, broken and worn impellers, frequent packing, loss of material being pumped, excessive lubrication, and, of course, labor. To keep pumps in satisfactory operation it is necessary that their bearings be inspected regularly. This inspection will in most cases need to be more frequent than that of the bearings on most other equipment, due to the nature of the work. The inspection schedule should include such items as the condition of the oil, noting if water and other foreign matters are in it; condition of the oil rings or chains; wear of the bearings; and end play of the shaft. The bearings should be drained of all old oil and flushed out at regular intervals and refilled with clean fresh oil.

It should be remembered that the horsepower required to drive a pump depends on the volume of material pumped. If the pump is operated at a lower head than it was designed for, the load will be greater. The horsepower required varies as the cube of the speed. It will also vary in some cases as the consistency of the material being pumped changes. Where the prime mover is overloaded it will probably be necessary to throttle the discharge until a safe load is reestablished. When pumps are operated in excess of their rated capacity their efficiency will be impaired, and there will be an increase in maintenance and upkeep costs.

▼ ▼ ▼

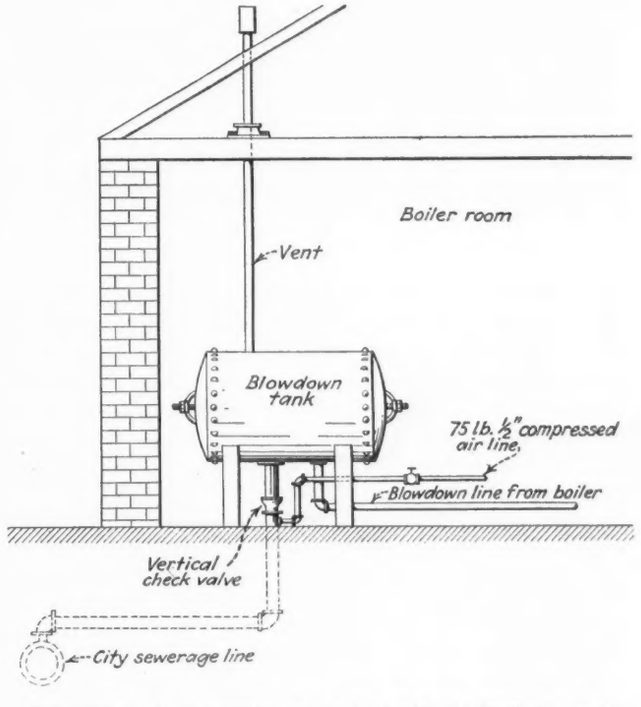
Compressed Air Used To Clear Blowdown Line

A BLOWDOWN tank was installed in a new industrial plant in a section of the country where winters are especially severe. This installation was piped as shown in the diagram. A serious difficulty resulted from this system, and until proper precautions were taken it was unsafe to use.

One day several weeks after the plant was placed in operation No. 1 boiler was blown down at 6 a.m. and No. 2 boiler was scheduled to be blown down at 7:30 a.m. The outside temperature was 15 deg. below zero and the frost line was a number of feet below the ground level. When No. 2 boiler was being blown down the fireman noticed that on opening the blowdown valves that there was no sound or feeling on the valves handles of escaping water under pressure. After closing the valve he examined the blowdown tank and discovered that the seam at one head had opened up between several of the rivets and steam was blowing out at some pressure.

An examination of the system disclosed that the drain from the blowdown tank to the city sewerage system had no pitch to it and that the frost line was below this level. The low temperature around the pipe had caused the elbow at the far end of the horizontal run and several feet of the line to freeze solid. Also, the vent was incased in ice where it passed through the roof, being of insufficient diameter at its opening.

A $\frac{1}{2}$-in. line was run from an air compressor and tapped into the drain just above the first ell. A vertical check was inserted between the tank and this point.

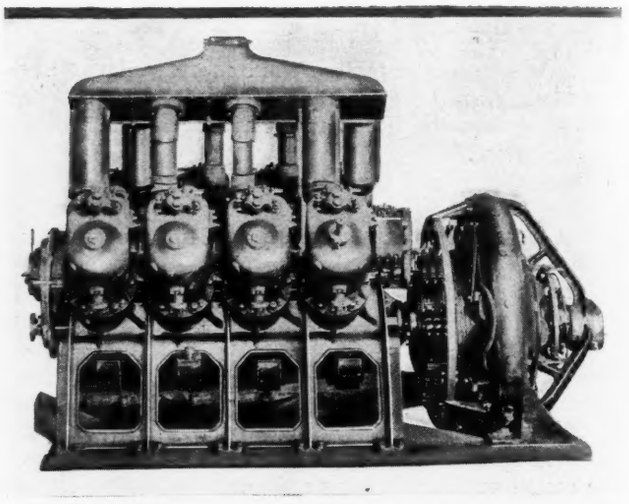


Compressed air connection made to drain of blowdown tank to insure complete drainage

Then after each boiler was blown down, during the extreme cold weather, the air line was opened for several minutes to blow the line clear of water. This was considerably cheaper than relaying the horizontal pipe underground and was a more certain method at these temperatures.

While the application of diesels to railcar service does not directly concern some power engineers, it has a distinct bearing upon the general position of this type of prime mover as a source of power. So it is included in the series by Colonel Allen as essential to a broad review of the oil engine field.—*Editor.*

By OLIVER F. ALLEN
Consulting Engineer
New York City



100-hp., 550 r.p.m., 8-cylinder "V" gasoline engine built in 1905 by General Electric Company for the first railcar

Application of Diesels To Railcar Transportation

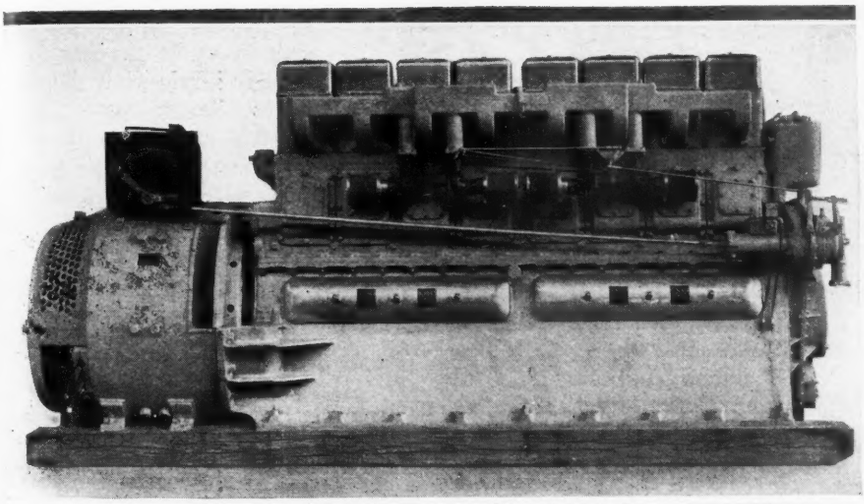
IN THE United States the first practical applications of internal-combustion engines on standard-gage railroads were not in locomotives nor railcars, in the modern sense, but in light cars for inspection and emergency service. These were virtually automobiles of the period with steering gear removed and flanged wheels put in place of road wheels. Such cars are still produced and used to a certain extent all over the world. Even in their latest form, sometimes with diesel engines, usually with gasoline engines, and nearly always with mechanical transmission of the motor bus or motor-truck variety, they cannot meet railroad requirements of sustained speeds, relatively infrequent stops and regular schedule operations. While serving a useful purpose on certain lines and for some services, this type of rail vehicle never has competed and probably never will seriously compete for regular passenger or freight service.

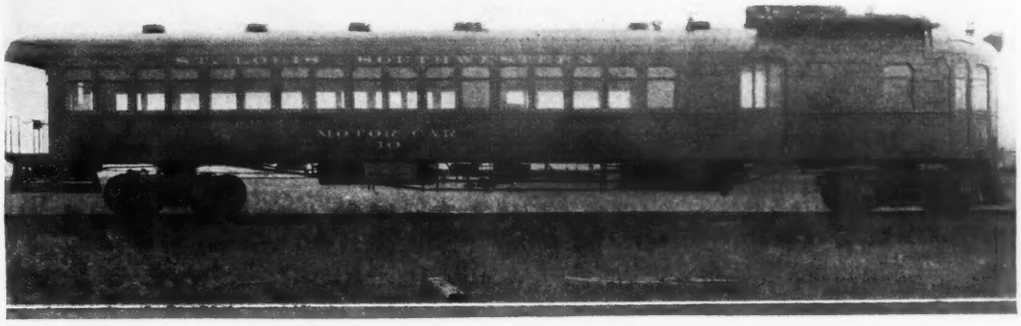
Railcars, in the present accepted sense of the word, were introduced in 1905. The McKeen car, first applied on the Union Pacific Railway, was powered by a 6-cylinder, 10 in. x 12 in. gasoline engine, driving one axle by a chain transmission with two gear ratios, and had an air-operated friction clutch. At the same time the General Electric Company built an electric drive car with an English Woolsley opposed-piston gasoline engine of 140 hp. at 430 r.p.m. This was soon followed by a 100-hp. 8-cylinder "V" engine at 550 r.p.m.

While other firms built a few cars of various sizes and types, all mechanical drive, the practical cars in service in this country in 1917 were confined to about 150 McKeen mechanical-drive and 95 General Electric electric-drive, all of about 100 hp., each, weighing about 35 tons complete and sometimes seating as many as 100 people. The high quality and general usefulness of these cars is shown by the fact that about a third of the McKeen and over a half of the General Electric cars were still in service two years ago. These cars were used on some 50 different railroads, including more than a dozen Class I lines. Some roads, such as the Frisco Lines and the Union Pacific, had more than a dozen cars each. In Europe both types were developed at about the same time, the Diesel electric being applied in Hungary in 1905.

By 1915 there were probably more than 300 railcars in regular passenger service on established railroad lines in the United States and Europe. Practically all of these were equipped with gasoline engines, and the majority employed mechanical-drive. Diesel engines with electric

A 535-hp., 950-r.p.m. Brill motor for modern railcars





An early railcar operated by the St. Louis Southwestern

drive were in use in Sweden as early as 1913; and a few other European railcars had diesel motors in them, with both electric and mechanical drives.

Some of these railcars were really functioning as locomotives, and there were also a few machines that could more properly be described as locomotives. There were not, however, any large number of units on any one route or system. The problems of servicing and maintenance were just being solved, consequently, all developments before that date must be considered as experimental from the railroad operation viewpoint.

From 1915 to 1919 the use of internal-combustion engines for rail service was studied intensively in the United States, France and England by the military authorities, and these studies and the application of larger gasoline engines than had previously been used for traction, particularly as applied to narrow-gage locomotives, tanks and tractors, prepared the way for the much more intensive study of these problems during the past dozen years.

The mechanical drive for rail service is of the same general type as that used in automobiles. In fact frequently the actual gear cases used in motor trucks and buses have been incorporated in the rail car. But the different requirements of service and the lack of elastic support by pneumatic tires developed many troubles which did not occur in road transportation. The manufacturers of railcar equipment have been rather slow to recognize this difference in service; only a few manufacturers have developed mechanical drive equipment really designed to meet the requirements of rail service.

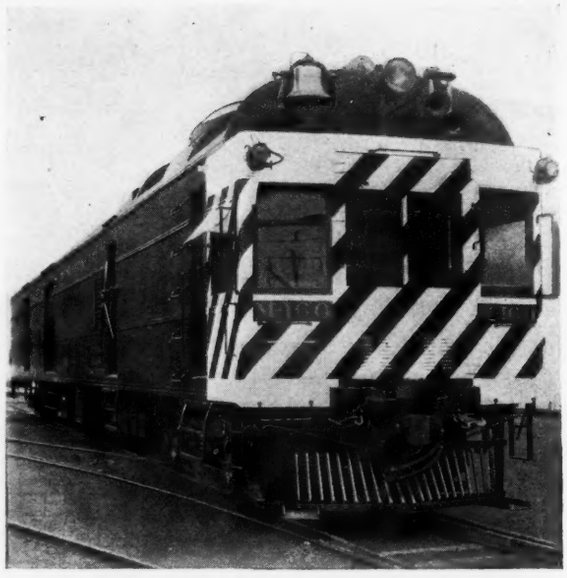
For railcar service the developments of gas-electric drive have been very rapid during the past ten years. Starting with small light-weight cars and mechanical drive, the tendency soon changed to larger cars, larger power plants, and electric drive. This did not, however, involve as much attention to the diesel motor as did similar developments in Europe, for the simple reason that on the American railroads where most of these cars are used a cheap fuel distillate which will work satisfactorily in a carburetor has been available at about the price of gas oil. Consequently there has not been the same incentive as in Europe to develop a railcar engine that would burn a heavier oil.

In the United States the developments resulted in some 600 gas-electric cars on standard-gage roads, with an average power plant of the last 100 cars purchased of about 400 hp., and of 800 hp. on a few cars.

It is doubtful if there are any more internal-combustion-engine railcars in service in Europe than in the United States, and there are certainly not as many heavy ones. On the other hand, there are a great many more diesel cars. The diesel railcars in this country are still more or less experimental so far as railway operation goes. There are only half a dozen in the United States and about fifteen in Canada. In Europe, especially in Sweden, Switzerland and Hungary, they are part of the regular operating program. Diesel-electric railcars have been in regular service in Sweden since September, 1913, and their application is being considerably extended. In Switzerland, as auxiliary to the main electric-contact traction system, additional railcars are being steadily put into service, and while most of them have electric drives, some new ones have mechanical drives.

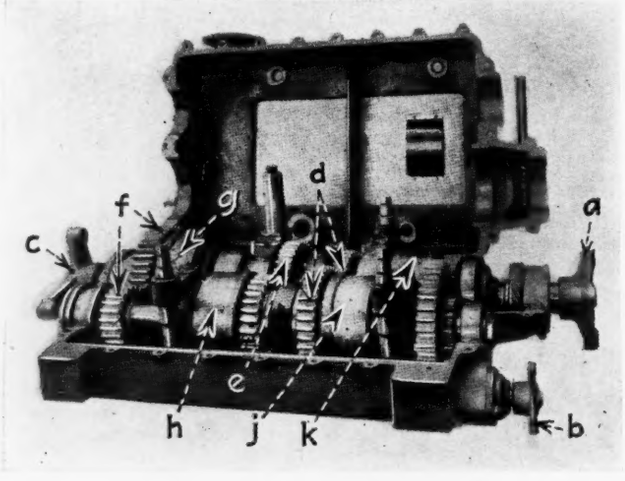
In Hungary a program was inaugurated three or four

years ago to supply all of the local passenger service 5,400 miles of Hungarian State Railway lines will be with railcars. When this program is completed the entire equipped with diesel railcars for all local passenger services. The only steam engine passenger trains will be the international trains. This railcar service was inaugurated with gasoline engines and has, during the past two years, been continued with diesel motors. Most of

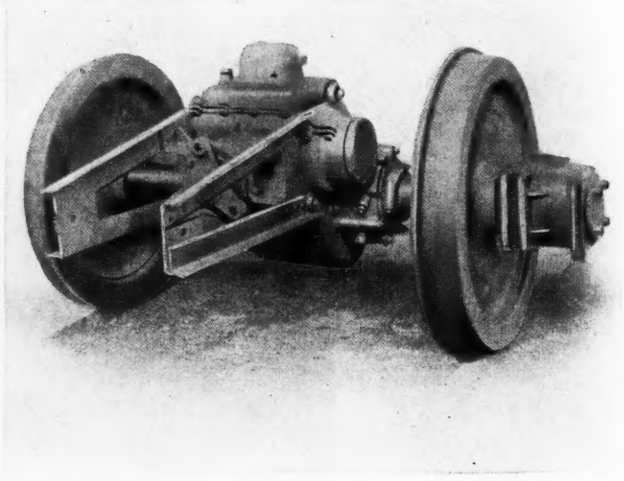


Railcar of the Atchison, Topeka & Sante Fe which handles a combination coach and a chair car

units with electrical drive. The outstanding feature is that the program so far has been satisfactory and that it does enable the railroads to meet bus competition. The power plants for these cars are so well designed and built that not only are they hidden away under the seats where the engine can not be inspected while the car is in regular service, but the stoppages due to power plant failures are fewer per train mile for the diesel railcars



Gear box of the Ganz, Budapest, car in which *a* is the engine drive; *c* the driven coupling; *d* and *f* the reduced speed gear; *g*, *j* and *k* the clutches



Ganz final-gear drive located on the axle, with the gear box bolted to the plate steel members forward

the 60 or 70 units now in service are of about 100 hp., consisting of a mechanical-drive motor car and one trailer. These cars are of low first cost, have low maintenance and low operating cost, so that they are actually meeting the bus competition, which shows itself in Hungary as well as in the United States. For some of the lines, where even with frequent service these units are too small, 200-hp. and 400-hp. units ar being considered. This may mean multiple-unit operation of the present 100-hp. units or multiple-unit operation of double cars of 200 hp., still retaining the mechanical drive, or it may mean larger than for the steam locomotives on the Hungarian State Railways.

There is every reason to expect American railroads eventually to handle all the branch-lines and some of the main-line local passenger traffic in railcars powered either with diesel or gasoline engines.

[This is the fifth of a series of articles the others of which appeared Oct. 13, Oct. 27, Nov. 10 and Dec. 1. Others will appear in subsequent issues; particular attention will be given to European developments.]

A Year's Review of Power Developments

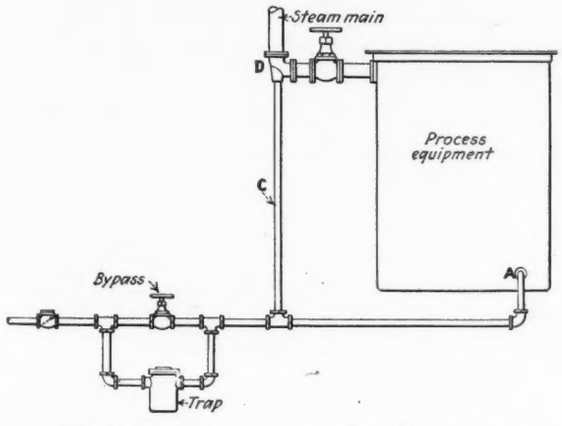
THE END of another year is nearly at hand and it is well to take inventory of the accomplishments of the past twelve months. This the Jan. 5 number of POWER will do for engineers interested in power problems. Fourteen articles will be devoted to a review of power developments during 1931. A special feature of this number will be a table that lists and gives the principal features of important steam plants in the United States and Canada that have gone into operation this year or are now under construction. Another table will give as similar tabulation of hydro plants.

Draining Industrial Equipment

IT IS generally required of process equipment, such as driers, heating coils, evaporators, etc., that it operate at maximum capacity. To obtain this capacity it is paramount that the condensed steam be removed as quickly as possible, and at no time should the heating surface be submerged with condensate. In some work close temperature regulation is required, which becomes difficult, and sometimes impossible, if the heating surface spasmodically becomes immersed. Thus the application of traps or drainage systems to process equipment must consider other factors than merely the removal of condensed steam. Every precaution should be taken to prevent sluggish operation.

The operation of a trap system depends upon pressure differentials for its success. The differential existing across the inlet and outlet of a trap of given size determines its capacity, and in selecting traps for given drainage duty the operating pressure, both inlet and outlet, must be considered. Where a single trap is arranged to discharge the condensate from a number of drainage points, the pressure differential between the points drained should be studied. If the differential is excessive, and means are not provided to correct it, a sluggish system will probably result, as the condensate coming from the low-pressure point will be held up by the higher pressure until a sufficient water-head has been built up to overcome the differential. This may cause part of the heating surface to become submerged unless the trap is installed sufficiently below the equipment drained to permit this head to be established without submerging the heating surface.

The illustration shows a trap installation that was made without regard to the existing pressure differential. Steam is delivered at *D* to a tank containing heating coils, which are trapped at *A*. The steam line entering the equipment was trapped at *D*, and the line run into



Unbalanced pressure causes sluggish drainage

that carrying the condensate from the heating coil. When the equipment is in operation the pressure at *D* is considerably higher than that at *A*, because of the friction loss through the heating coils. Thus the higher pressure from *D* held the condensate up in the coils and prevented its proper drainage. In this case the fuel capacity of the equipment could not be secured, and the operator blamed the trouble upon the trap, whereas actually the difficulty was caused by improper installation. In this case the remedy employed was to install a valve in the line at point *C*, closing it sufficiently to produce the same resistance in the line from *D* to the trap as existed in the steam coils, thus equalizing the pressure.

The great variety of conditions that must be met in the installation of traps to process equipment limit the general rules for installation to relatively few simple observations. Generally speaking, wherever possible traps should be below the equipment to be drained. Where space is not available for such installations, the trap may be above the equipment, and satisfactory operation secured, provided proper vent arrangements are made. Under such conditions the steam pressure must, of course, be high enough to force the condensate to the elevation of the trap and out through the trap against the pressure existing in the discharge line.

Sometimes it is desirable to run discharges from traps along the ceiling, rather than under the floor. This requires sufficient steam pressure to overcome the discharge pressure, friction losses and head due to water in the line between trap and discharge header.

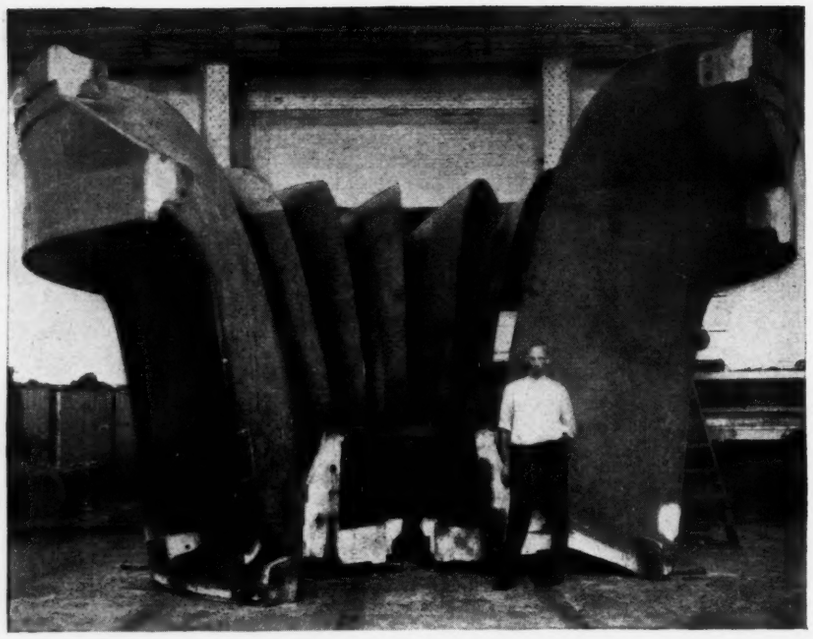
Traps should always be installed with a bypass so that they may be inspected or repaired without shutting down the equipment they serve. It can also be used to drain the equipment if for any reason the trap sticks in the closed position.

Some engineers claim that bypasses should not be installed in small plants when the traps are maintained by the process operator. These operators frequently open the bypass, believing that by so doing they can increase the capacity of the process equipment. The steam leaking through the open bypass constitutes considerable waste. However, this is not a valid reason for omitting the bypass, but rather a reflection upon the superintendent for not instructing his operators regarding its proper use.

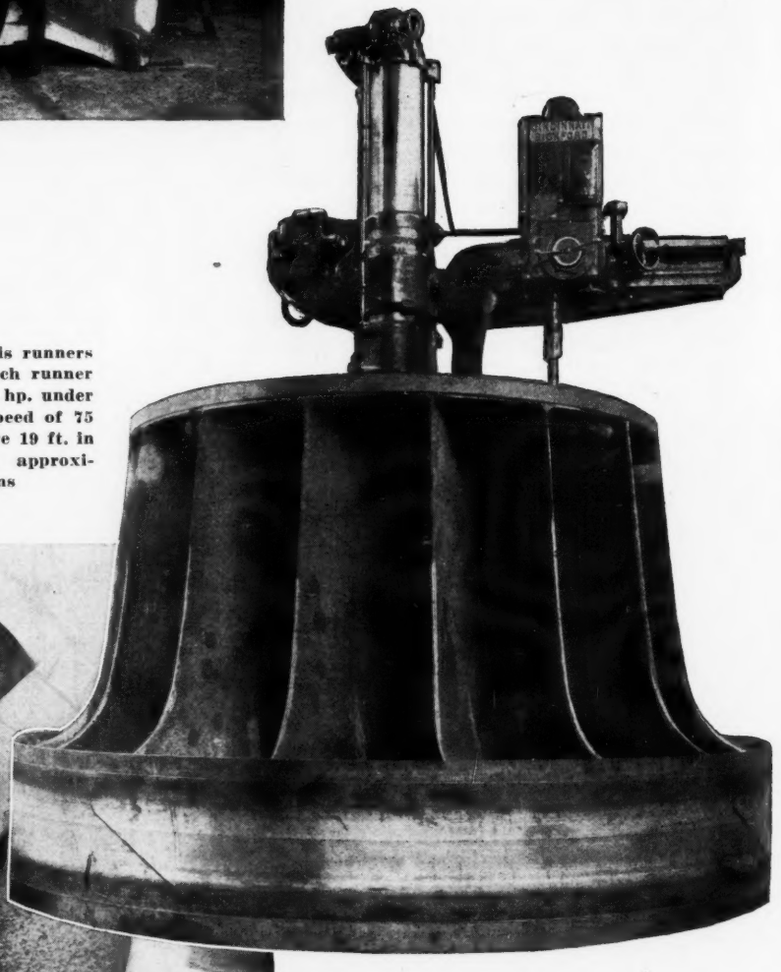
This discharge from traps is generally collected in one or more headers, and may be delivered to an open feed water heater, sump or receiver. The discharge should be amply sized so that no back pressure will build up in it. When discharged to the receiver or open heater the water should be admitted above the water level in the receiver equipment. When discharged to a feed-water heater the drip helps to heat up the feed water with which it mingles, and is returned to the boiler. When receivers are used the drips may be pumped to the boiler drum directly, or a lift trap system may be installed for the same purpose. When this is done a lift trap at the receiver elevates the return to a second trap located above the boiler drum at sufficient height to permit the drips under boiler pressure to flow by gravity into the boiler drum. Drips returned by this system should not be admitted to the boiler through the feed-water line, but a separate connection should be made. Manufacturers of this type of trap recommend that the drip be admitted through the blowoff connection to the boiler.

A great variety of traps are available for use with process equipment, and many are designed for special uses. Where the load is steady and the quantity of condensate to be handled is not great thermostatic traps may be used. Their greatest use is found on radiators of steam heating systems, and on coils of air heating equipment. Where the load is apt to be variable, and for large quantities of condensate, either bucket or float-type traps of various designs are available. When it is desired to discharge the condensate against pressures higher than the steam pressure in equipment drained, lift traps must be used. A special form of lift trap is used when draining vacuum equipment.

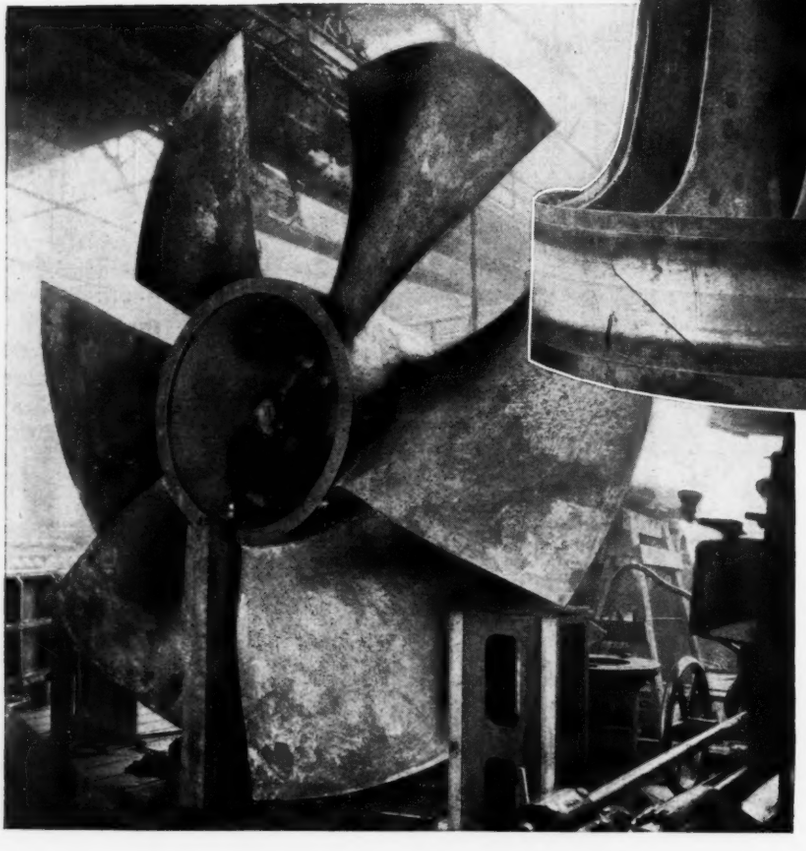
WATERWHEELS FOR BEAUHARNOIS



The runner for each of the four initial main turbine units now being installed in the power house of the Beauharnois Power Corporation on the St. Lawrence River near Montreal are cast in four sections



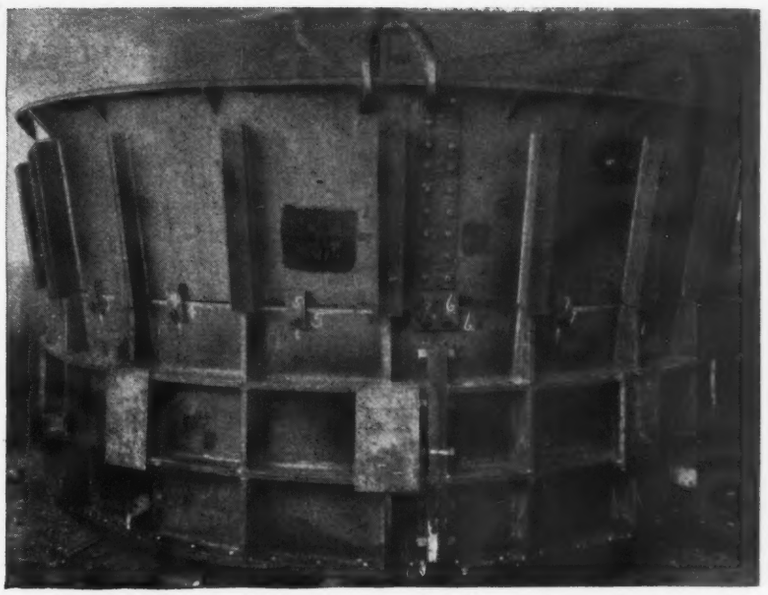
One of the Beauharnois runners on a boring mill. Each runner has a rating of 53,000 hp. under an 80-ft. head at a speed of 75 r.p.m. The runners are 19 ft. in diameter and weigh approximately 115 tons



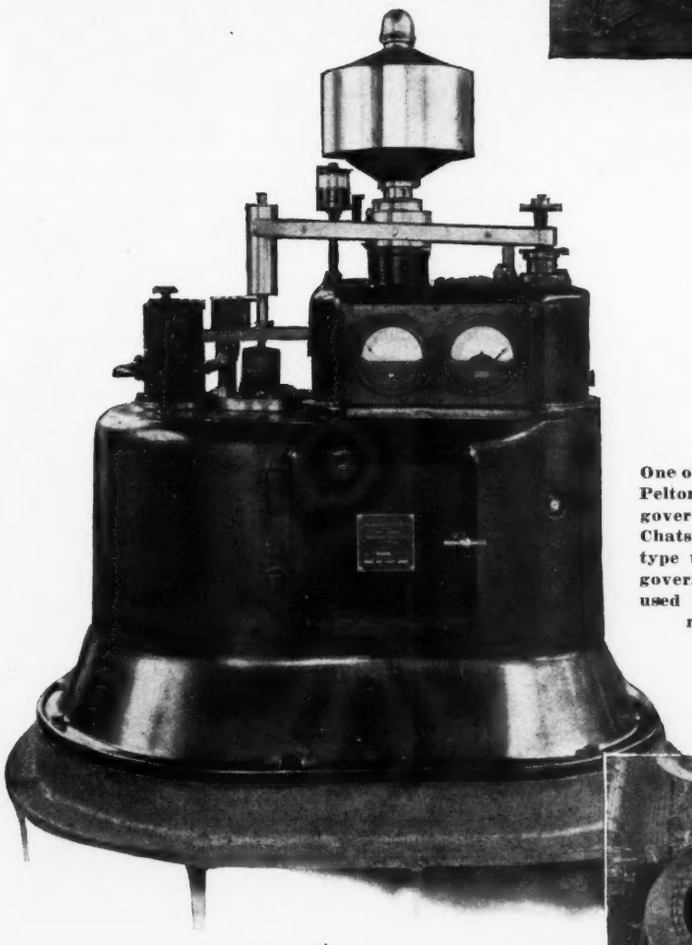
One of the eight propeller-type runners for the Chats Falls plant on the Ottawa River. These runners are cast in one piece and are 16 ft. 3 in. in diameter. They will operate under a head of 53 ft. and will develop 28,000 hp. each

Photographs supplied by the Dominion Engineering Works, Ltd., Montreal, Canada

AND CHATS FALLS DEVELOPMENTS



Throat ring and draft-tube liner for one of the Chats Falls units. The throat ring, which is made of plate-steel welded construction, is in four sections, bolted and welded when erected at the plant. The flange at the upper end is bolted to the lower distributor ring and the lower end is riveted and welded to the top of the draft-tube liner



One of the eight Morris-Pelton actuator-type governors for the Chats Falls propeller-type turbines. Similar governors are being used on the Beauharnois turbines

One of the built-up speed rings, head cover and lower distributor ring for the Chats Falls units. The built-up speed ring comprises nine stay vanes and one baffle vane. At the bottom ends these vanes are anchored into the concrete substructure. At the top ends the vanes are bolted to the stay ring, which is cast in ten sections and bolted together

A Marine Critical-Pressure Boiler

THAT marine engineering circles are eager to improve the efficiency of their steamer power plants is evidenced by the installation of a Benson 3,200-lb. boiler and high-pressure turbine on the Hamburg-American liner Uckermark.

Three points are particularly important in design of engines for ship propulsion: high economy, small space for engine boiler and fuel, and light weight. The diesel engine has been very successful in meeting these demands, and became, therefore, a real competitor of the marine steam plant. While the stationary steam plants developed very rapidly within the last ten or fifteen years, the development of marine steam plants has been considerably slower. Marine engineers often seem to be overly conservative, and even averse to scientific advances, but this reserve is easily comprehensible. Safety and reliability of new constructions have to be tested thoroughly before they can be used aboard ship.

That leading men of the lines are looking for improvements is shown by the action of the Hamburg-American line in equipping the 9,000-ton steamer Uckermark with a Benson boiler and a high-pressure steam turbine. Results of the long trial trips are now available.[1]

This freighter was originally equipped with 220-lb. boilers and a turbine that had been removed from one of the Hamburg-American express ships of the Albert Ballin class, during a recent rebuilding program.

The management then decided to install a Benson boiler for experimental purposes. This boiler displaced one of the old boilers, and it has sufficient capacity to generate all the steam required to operate the vessel. A high-pressure turbine was added, coupled ahead of the existing 220-lb. turbine. The remaining old boilers were left on board to be held in reserve.

The Benson boiler is shown, Fig. 1. The tubes *b*, exposed to radiant heat from the furnace *a*, are made from molybdenum steel and are welded to 32 forged Siemens-Martin steel headers which divide the boiler into 16 sections, each consisting of an upper and lower header joined by 11 vertical tubes. The individual boiler sections are connected in series to provide a circulation path of sufficient length to assure complete evaporation.

The superheater *d* and economizer *e* sections of the boiler are built with seamless-drawn Siemens-Martin steel tubes. A welded plate-type air heater furnishes preheated air to the oil burners under forced draft supplied by a motor-driven turbine-vane fan. The flue gases leaving the air heater are carried off by a motor-driven induced-draft turbine-vane fan.

Originally the furnace was provided with oil burners arranged in two groups of five burners in each furnace side wall, as shown at *c* in Fig. 1. This burner arrangement resulted in uneven tube stresses and was changed subsequently to include only four burners in each side wall. The vertical tubes exposed to the furnace heat are protected by "nichrotherm" plates that withstand the highest temperature. High-quality refractories protect the exposed headers and the furnace walls.

Originally the path of the fluid and the heating surface of the several sections of the path were as follows: through the economizer (3,400 sq.ft.), to the radiation boiler (1,350 sq.ft.) and through the superheater (800 sq.ft.). With this connection the critical point of water was reached in the boiler part exposed to radiant heat. This caused strong evaporation in this part, so that the pipes were not sufficiently cooled and some broke. The small amount of water in the thin pipes, however, prevented dangerous effects to the boiler, but the flames were blown out.

After the first trial trip the economizer and boiler were divided into sections and the circulation arrangement was changed to the following: to economizer 1 (1,700 sq.ft.), to radiation boiler 1 (675 sq.ft.), to economizer 2 (1,700 sq.ft.), to radiant boiler 2 (675 sq.ft.), and to the superheater (800 square feet).

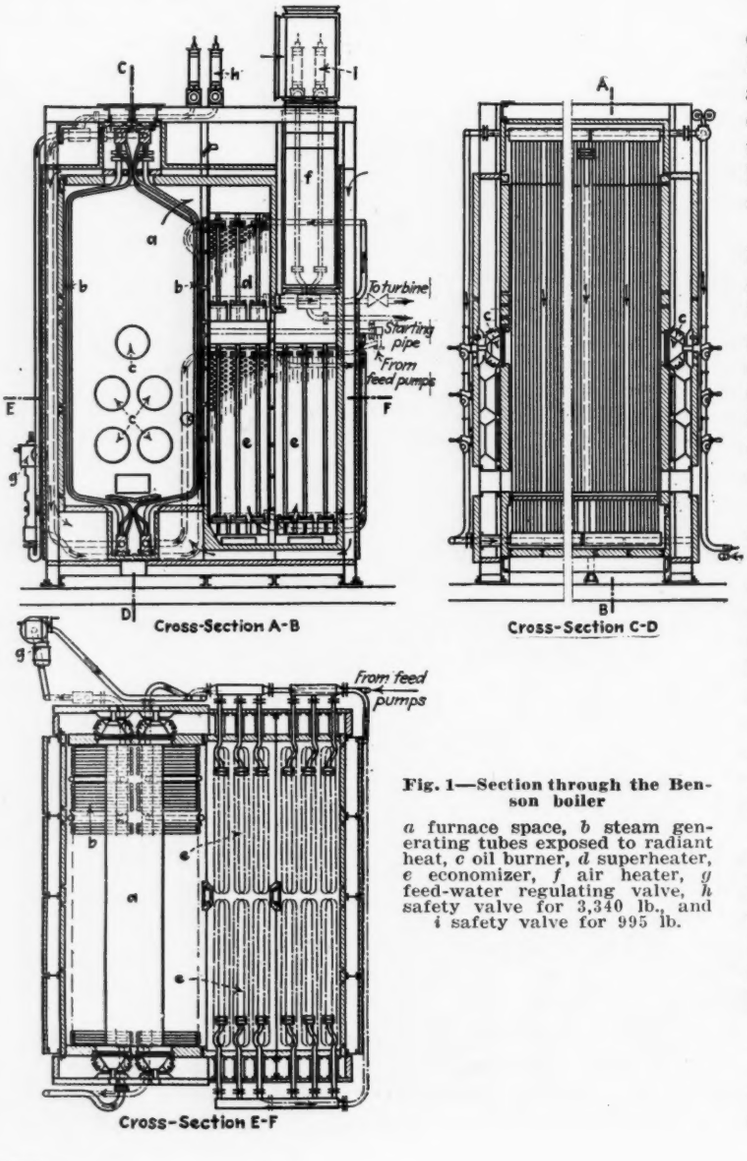


Fig. 1—Section through the Benson boiler

a furnace space, *b* steam generating tubes exposed to radiant heat, *c* oil burner, *d* superheater, *e* economizer, *f* air heater, *g* feed-water regulating valve, *h* safety valve for 3,340 lb., and *i* safety valve for 995 lb.

[1]See "The Superpressure Steam Plant Aboard S.S. Uckermark." By E. Goos, in V.D.I. *Zeitschrift*, page 1433, Vol. 75.

With this new arrangement the critical point of water is reached in economizer 2 after the water has absorbed 165 B.t.u. per pound. Behind the radiation boiler 2 the steam has a pressure of 3,200 lb. per square inch and a total temperature of 752 deg. F. Before the superheater a pressure-reducing valve is arranged so that the steam enters the high-pressure turbine at 853 lb. and 860 deg. F. total temperature.

The high-pressure turbine is erected on the body of the low-pressure turbine, which latter was already in the steamer before the high-pressure plant was installed.

The entire Benson boiler weighs only 110 tons; one-third of this weight embraces the boiler proper, another third the steel framework and casing and the remaining third the oil burners, refractories and accessories. The total water and steam within the boiler weighs about 1.1 tons.

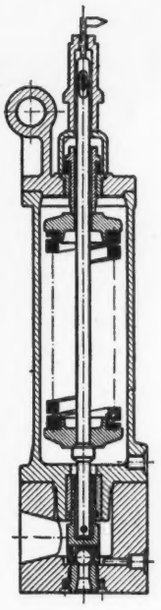


Fig. 2—Relief valve

In contrast thereto, the original marine boiler displaced by the Benson unit weighed 171 tons and had only one-third the steaming capacity of the latter.

Distilled water is used for boiler feed and is obtainable from a vacuum- and a pressure-type evaporator, each of which has a capacity of 27.5 tons of water daily. The vacuum-type evaporator furnishes the feed-water make-up and is generally in continuous service. The steam generated in this evaporator is passed into the main condenser. The pressure-type evaporator supplies the feed-water storage tanks and is used only intermittently.

Two motor-driven high-pressure reciprocating boiler-feed pumps each have six single-acting plungers. The cylinder block is divided into three sections, each containing two vertical cylinders. The suction and discharge valves are some distance away from the pistons, creating a space for a body of water which reciprocates with the movement of the pistons. This water serves as a hydraulic piston which forces the water entering the suction valve out through the discharge valve into the boiler. The connecting pipes have double walls for circulating cooling water in the annular space between them, for the purpose of removing the heat generated by the friction of the reciprocating water column. The quantity of feed water pumped is regulated by adjusting the maximum opening of the suction valves.

Lesser irregularities in steam generation is compensated for by blowing off steam into the condenser or by regulating the speed of the feed pumps between 95 and 115 r.p.m. Before the high-pressure steam enters the condenser it is passed through a desuperheater, to reduce its pressure, and its temperature to about 292 deg. F. The injection water for desuperheating is obtained from the boiler-feed line.

Since it is required to maintain a constant boiler pressure of 3,250 lb., the automatic reducing valve is especially important. It may be regulated either mechanically or electrically by hand control, or may be automatically regulated by an electrical-contactor regulator.

The time lag between the change in steam pressure and the functioning of the regulating valve must be compensated for by a suitable counter adjustment to avoid overtravel. A commutator, rigidly attached to the regulating motor shaft, provides for the synchronous functioning of a small adjusting motor. This small motor is geared to move a piston in an oil cylinder. The movement of the latter breaks the indicator contact and shuts down the main regulating motor.

The boiler is started by slowly pumping water through it until a small quantity of water has escaped through the blowoff connection leading to the condenser. The fans are started next, and the burners are lighted, one after another. All gages are read, and the fires are adjusted to obtain the saturated temperature corresponding to the existing pressures.

When the 995-lb. steam leaving the superheater attains a temperature of 662 deg. F. the turbine is warmed up, and when the pressure reads 3,195 lb. in the boiler, with a steam temperature of 712 deg. F., the pressure-regulating valve is cut into service. The turbine is then started with a pressure of 995 lb. and a steam temperature of 752 deg. F. at the superheater outlet. All pressure gages, draft gages and thermometers are read carefully throughout the boiler operation, for the temperature of the water or the steam leaving the boiler section must not exceed 752 deg. F. If the temperature falls to 716 deg. or rises above 869 deg. an alarm, consisting of a signal lamp and horn, automatically comes into action.

As no means is available to compensate for the various irregularities that occur in operation, it is necessary to govern the feed input by steam output. This regulation may be accomplished by cutting burners out or in or by varying the fuel oil pressure; by changing the feed input;

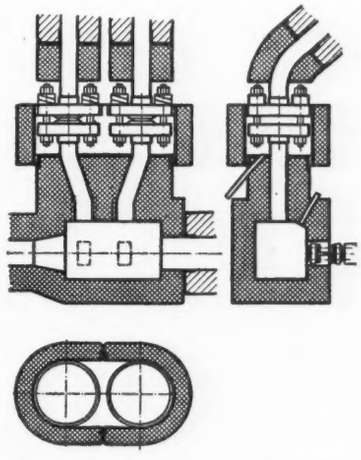


Fig. 3—Type of tube connection employed

by changing the turbine speed; or by blowing off steam to the condenser.

When shutting down the boiler, the burners are gradually turned down and the feed input is reduced. After shutting down the turbine, the relief valve to the condenser is opened. Next the oil burners are gradually turned down and the pressure-regulating valve is closed. The feed pump is operated at half speed to allow the boiler pressure to drop slowly. When the steam temperature at the boiler outlet has dropped to about 212 deg. F. the feed pumps are shut down and all accessories are cut out of service.

During operation the boiler-heating surfaces must be cleaned frequently by steam soot blowers. It is necessary to test both the boiler water and the make-up water regularly. Only a small percentage of the solids in the water reach the turbine. Most of the salts are precip-

PERMISSIBE WATER CONCENTRATION

Grams per Gal.	Hours Between Cleanings
1.16	200
2.92	100
5.84	50
11.68	24
17.52	18

itated on the heating surfaces or are retained by the boiler water. When the critical point is passed in the economizer a large surface is presented for scale precipitation in a part of the boiler where it can do little harm. The relatively low temperature, furthermore, will cause a more gradual precipitation, which spreads uniformly over the entire surface during the long travel of the water through the tubes. Another favorable feature is the fact that the scale deposit occurs on the surfaces that are in constant contact with relatively low gas temperatures and consequently there is little danger even when a fairly thick deposit of scale exists.

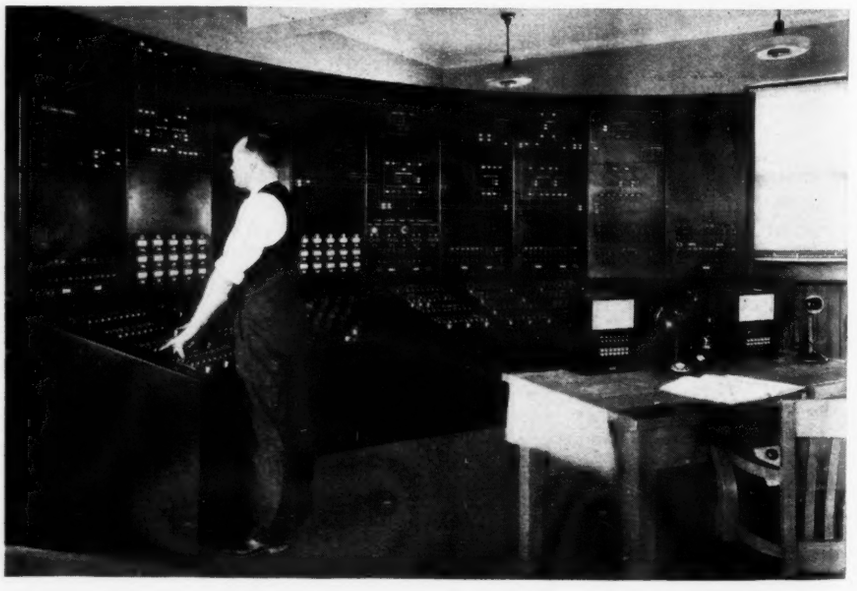
The boiler tubes may be cleaned internally only by flushing. For optimum results a practically pure feed water with a slightly alkaline reaction is recommended. The following tabulation shows how long the boiler may be operated, continuously between cleanings with feed water of different concentrations:

▼

Supervisory Operation Gives Control of 300 Circuits To Dispatcher

THE nerve center of 24 of the 27 substations and switching points, supplying 11,00 volt, 25-cycle single-phase power for the Reading Company's $21,000,000 initial railway electrification in the Philadelphia suburban area, is a Westinghouse Visicode supervisory control desk installed at Wayne Junction. The desk is semi-circular in shape, as shown in the picture, and is constructed entirely of steel. Colored indicating lamps showing the position of each piece of apparatus controlled, together with an illuminated system diagram on the vertical section of the desk, give the dispatcher a physical picture of power conditions on the four sets of electrified tracks radiating from his Wayne Junction headquarters.

The three hundred operations at the dispatcher's command are performed over a set of telephone wires to each of the four divisions. To show that the orders have been fulfilled the same wires carry back to the dispatcher signals to light the proper indicating lamps. Predetermined coded impulses are alternately transmitted and received to operate the desired piece of apparatus, such as a circuit breaker, and to operate the corresponding indicating lamps on the dispatcher's desk.



Supervisory control desk from which 300 control operations can be made over four pairs of telephone wires

CURRENT COMMENT

Jointing Material for Steam Turbines Diaphragms

DURING the last two years I have come in contact with several engineers who have been somewhat at a loss to find a suitable diaphragm jointing material for steam turbines operating at pressures of 175 to 350 pounds.

A diaphragm joint made from a mixture of cast-iron filings and manganesite putty worked to a fair consistency will make a practically unbreakable joint and prevent any leakage of steam from the high- to the low-pressure stages.

ROBERT H. NORTON,
Assistant Superintendent,
Zamora, Mexico. Guanajuato Power & Elec. Co.

More Waterwheels of Ancient Lineage

AS A SEQUEL to the account of the fifth century French turbine in the Oct. 6 number, it may be of interest to know that such wheels are still in use in the Great Smoky Mountains. In the valleys the mills are run by overshot wheels, factory-made turbines, or flutter wheels, but these are beyond the reach of the mountaineers. Among the mountain people the home-made wooden impact wheel is standard construction. Last summer I visited one, in ruins, near Elkmont, Tenn., and two in good working order near Gatlinburg; and I was told there were others farther up the creeks, in more inaccessible places. The picture shows one of the Gatlinburg wheels.

These wheels are cut out of yellow poplar, with the grain along a diameter. The disk is 24 in. to 28 in. diameter, and 5 or 6 in. thick. Two iron hoops are usually put on as a protection against splitting. Then the buckets are formed with mallet and chisel, and a square hole made through the center for the shaft. The blades are curved according to the ideas of the builder.

The vertical wooden shaft has at its top an iron ex-

Water flows onto the wheel down a spout to the right of the vertical shaft

tension, which, in turn, carries the revolving mill stone. The stones, made by hand from native rock, are about 22 in. diameter.

Water flows down a spout, inclined at about 40 deg. and with a fall of 8 ft. or more, onto the wheel. When the mill is to be stopped, the water flow is diverted, either at the top or the bottom of the spout.

I was glad to learn from the article that wheels of this type have such an ancient lineage. They must have been one of the earliest devices by which water power was turned to the use of man. O. H. TRUMAN.

Houston, Tex.

Welded Fire Tube Boiler

ON A RECENT visit to the main shops of the Cumberland and Pennsylvania Railway Company, at Mount Savage, Md., I had the pleasure of inspecting a boiler which was being fabricated. This is a vertical, fire-tube boiler of the conventional submerged-head type. It is to replace a boiler now in service in the wrecking crane. It is 48 in in diameter, 108 in. high, containing 104 two-inch tubes. The design of the original boiler is followed, except that all seams and connections are welded, with the exception of the top head stays, which are riveted to the wrapper sheet.

Decision to weld this boiler was arrived at after experimenting with a small boiler, built in the company shops and installed in one of their houses. This boiler is successful at 15 lb. working pressure, while the larger boiler is to work at 120 lb. pressure.

Incidentally, it might be mentioned that this company has been interested in arc welding since 1910, when a motor-generator set was installed for that purpose.

Mount Savage, Md. R. L. BOOTH.

Boiler Water Conditioning

WITH REFERENCE to the article by F. G. Straub in the Nov. 10 number, in which he comments on an previous article by J. B. Swift on the conditioning of boiler feed water, I do not see why it is necessary to maintain any degree of caustic alkalinity in the theoretically perfect boiler feed water. Mr. Straub has done a great deal of research work on protective and non-protective alkalinity, but so far I am not "sold" on the idea. I operated a boiler for a long period on water containing caustic soda at its source, and the blow-off water would have taken the hide off an alligator, but the tubes and shell remained in excellent shape. My predecessor operated another boiler at the same place, which after six years was retubed and put into service again, the tubes having literally rusted through.

Down through Death Valley, Nev., and particularly at Mono Lake, the ground waters are heavily alkaline, yet both boilers and evaporators last as well as where better waters are obtainable; consequently, I cannot believe that any water in the Eastern states can be concentrated to a point where its caustic soda content can approach many natural waters in California and Nevada. Almost without exception, the country rock from Pittsburgh to Denver is limestone, the presence of which precludes the presence of caustic alkalies except in infinitesimal quantities in ground waters.

Now as to caustic alkalinity, why have any at all? For conditioning hard water, water containing iron or acids, or albuminous material, what better reagent can be found than calcium hydrate? It has two merits, cheapness and the fact that any excess over what is required is almost entirely insoluble; moreover, it removes the carbonates and bicarbonates of calcium and magnesium without substituting anything in their place. The water in central South Dakota is high in calcium sulphate. Here we use 45 lb. of soda ash to 1,000 gal. of water. The resulting water was soft so far as using soap was concerned, but it primed.

Mr. Swift is right, that a few simple tests can be applied intelligently by one who cannot read or write, provided he is not color blind also. I should add one point more: the occasional use of nitre-cake (acid sodium sulphate, $HNaSO_4$) to correct any excessive alkalinity. Nitre cake has the advantage of an acid reaction without being seriously detrimental to the boiler metal.

In my statement, I except water which occurs near salt springs, or which is drawn from badly contaminated sources; yet one can hardly imagine anything worse than that from the Chicago drainage canal. The water is so bad in many mining districts that mosquito larvae cannot live in it, yet I do not know of an instance where a simple lime treatment, followed in a few cases by aluminum sulphate or barium hydrate, does not produce excellent boiler water. My experience in this runs through the coal mining districts of Indiana, Illinois, Missouri, Iowa and Kansas, the lead fields of southeast Missouri, and the Joplin-Oklahoma zinc district, also several copper camps in Arizona and Nevada. The same condition obtains in all of them: the ground water not only contains salts of lime and magnesia, but ferrous sulphate and sulphuric acid from the decomposition of iron pyrite; also in the copper mines, copper sulphate, which is as destructive of iron and steel as sulphuric acid.

L. R. BAKER,

Cleveland, Ohio. The National Acme Co.

READERS' PROBLEMS

Conducted by L. H. MORRISON

CONSERVATION OF HEAT IN BLOWDOWN—*Will you kindly advise me if the following assumptions are practical in the conservation of heat from boiler blowdown.*

Blowdown is 2,500 lb. per hour at 460 deg. F., which we should like to use in heating 48,000 lb. per hour of make-up water entering at 75 deg. F. This is 19 lb. of make-up per pound of blowdown. With the temperature at blowdown of 460 deg. F., we have assumed a temperature at the waste of 115 deg., which gives a drop of 345 deg. F.

If the temperature assumed at the waste is practical, then each pound of blowdown drops in temperature 345 deg., which is transferred to 19 lb. of make-up. This should increase the make-up temperature 345 ÷ 19 = 18 deg. The make-up should leave the heater at 75 + 18 = 93 deg. F., which gives a terminal temperature difference of approximately 22 deg.

We are also uncertain as to the pressure we must maintain in this heat exchanger; it would seem necessary to hold the pressure at about 450 lb. to avoid flashing.

Regarding the dimensions of flash tanks, will you kindly advise what size of tank would be required in flashing 22,000 lb. of condensate at about 445 deg. F. and 400 lb. pressure, producing about 3,900 lb. per hour of 15-lb. steam. R.C.G.

With a properly designed heat exchanger the assumed temperature conditions can be obtained. The entrance pressure would need to be at least 400 lb. to prevent flashing in the exchanger.

Dimensions of flash tanks are by no means standardized. The actual flash from 22,000 lb. of condensate at 445 deg. F. and 400 lb. pressure into 15-lb. steam will be about 4,750 lb. instead of 3,900 lb. A tank 42 in. diameter x 8 ft. should be ample to care for the flash, assuming that the condensate flow is constant.

SIZE OF STACK—*Two boilers, each 150 hp. with 30 sq.ft. of grate surface each, burn 3½ lb. of coal per square foot of grate surface per hour. The stack temperature is 533 deg. F. and the fire room temperature is 68 deg. F. What is the height of stack, and its diameter, with the probable draft in inches of water? Stack to be built of steel on a concrete foundation, the wind pressure assumed as 40 lb. per square foot.* J.F.N.

The rate of coal consumption is low, for the hourly coal consumption of $3.5 \times 30 \times 2 = 210$ lb. will evaporate less than 2,100 lb. of water per hour, while the boilers are rated at $2 \times 150 \times 34 = 10{,}200$ lb. of water evaporated. This means that the fire will be exceedingly slow, which calls for a low draft.

Experience indicates that for such low firing rate a stack of 36 in. diameter would be ample. The best approximate method of calculating the stack height is the Kent formula, in which *coal per hour* $= 16.65\ (A - 0.6\sqrt{A})\sqrt{H}$.

Where A = Effective stack area in sq.ft.

H = Height, ft.

Substituting the coal rate and the assumed stack area of 7 sq.ft.

$$210 = 16.65\ (7 - 0.6\sqrt{7})\sqrt{H}$$

$$2.33 = \sqrt{H}$$

$$H = 5.4 \text{ ft.}$$

This height is, of course, exceedingly low and is not practical.

The better plan, since the boilers' output is so low, would be to run one boiler with the second one idle. In which case each boiler should have a stack of its own, of about 34 in. diameter, resting on the boiler brickwork.

Stacks up to 48 in. are usually guyed to resist wind pressure.

This question has the appearance of one asked in an engineering school quiz, in which event the instructor probably desires the student to go through complete calculations. For this "Draft and Chimney Capacity," by J. G. Mingle, published by the D. Van Nostrand Company, should be consulted. In any event the question contains absurd data.

A Question for Our Readers

WE HAVE HAD considerable discussion on the necessity of checking up on motor loads, without having established a general practice in our plant for doing this work. I should like to hear from some of POWER *readers as to what their practice is in making load tests on motors. How frequently should this be done? What use is made of the meter reading? What kind of meters are used for these tests and what benefits have been obtained from them? We have a connected motor load of about 2,700 hp., the individual motors ranging in size from 2 to 250 horsepower.* C.O.H.

Suitable answers from readers, if received promptly, will be paid for when published.

COMPRESSOR PISTON DISPLACEMENT—*What is the piston displacement of a compound air compressor with cylinders 12 and 20 in. diameter and 14 in. stroke, running at 250 r.p.m.?* M.R.B.

The reason for calculating the piston displacement of a compressor is to ascertain the amount of air handled, which is the piston displacement multiplied by a proper factor. Consequently, in a compound compressor the only piston displacement of interest is that of the low-pressure cylinder, since the high-pressure cylinder handles all the air drawn into the low-pressure cylinder.

The formula for piston displacement is $PD = 0.7854\ (\textit{cylinder dia.})^2 \times (\textit{stroke}) \times \textit{no. of strokes}$, the values being in feet. Substituting the values given in the question

$$PD = 0.7854 \times \left(\frac{20}{12} \times \frac{20}{12}\right) \times \frac{14}{12} \times 2 \times 250 =$$

1,272+ cu.ft.

But this is not the volume of cubic feet of air actually handled by the compressor. The clearance and valve loss must be considered, which may reduce the volumetric efficiency to 70 or 80 per cent.

FURNACE VOLUME FOR GAS BURNING—*What should be the height of a horizontal return-tubular boiler setting for burning natural gas of 1,100 B.t.u. per cubic foot. The shell is 60 in. diameter and 16 ft. long. Give the height for sea level and also for an elevation of, say, 8,000 ft.* J.H.H.

A fair and conservative ratio of furnace volume to boiler heating surface with gas burning is 0.2, that is, 0.2 cu.ft. of furnace volume for each square foot of surface, which will permit the boiler to be operated at 200 per cent rating. A 60 in. x 16 ft. horizontal return-tubular boiler has approximately 1,000 sq.ft. of heating surface, consequently the furnace volume should be $0.2 \times 1{,}000 = 200$ cu.ft. Assuming that the effective furnace is to be one-half the boiler length, and with a furnace width equal to the boiler diameter of 5 ft., the furnace height should be $200 \div (5 \times 8) = 5$ feet.

For a high altitude, which means that the admission air contains less weight of oxygen per cubic foot, the area of the air passage at the burner would need to be increased in ratio to the absolute pressures. At sea level the area is approximately 0.2 sq.in. per square foot of boiler-heating surface. At 8,000 ft. elevation the atmosphere pressure is 560 mm. or $\frac{560}{760} \times 14.7 = 10.8$ lb. per square inch. Assuming the temperature to be the same as at sea level, the oxygen per cubic foot of air at 8,000 ft. will bear a ratio of the oxygen per cubic foot at sea level of $\frac{10.8}{14.7} = 0.73$. Consequently if the air inlet area per square foot at sea level is 0.26 sq.in., then at 8,000 ft. elevation it should be $0.26 \div 0.73 = 3.5$ sq.in. per square foot of boiler-heating surface.

Delta-Connected Banks of Transformers in Parallel

THE QUESTION

TWO BANKS of three 150-kva. transformers are connected delta-delta and in parallel on the primary and the secondary sides. If one transformer was to burn out would it be possible to connect the two remaining transformers open-delta and operate them in parallel with the delta-delta connected bank? If this can be done will the open-delta connected bank have any effect on the capacity of the delta-delta connected transformers? All these transformers are alike, having been supplied by one manufacturer.

M.A.B.

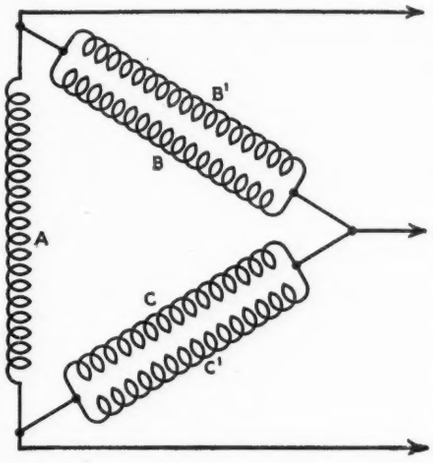
IN THE many answers received there is a general agreement that two transformers connected open-delta in one bank can be operated in parallel with three transformers connected closed-delta in another bank. There is, however, a disagreement on the question of the capacity of the banks when connected in parallel and supplying a balanced load. Some of those answering the question assumed the balanced load that could be supplied without overloading the transformers is equal to the capacity of the two banks. The delta bank has a capacity of $3 \times 150 = 450$ kva., and the open-delta bank a capacity of $3 \times 150 \times 0.58 = 261$ kva. Therefore on the basis of the preceding premise the capacity of the two banks would be $450 + 261 = 711$ kilovolt-amperes.

This, however, is not correct, since the two open-delta connected transformers are in parallel with two of the transformers in the delta connected bank. The connection is equivalent to three transformers connected closed-delta, but two of them having two similar windings in parallel and the third transformer with a single winding, as in the figure.

A, *B* and *C* may be considered the windings of the delta-connected bank of transformers when *B'* and *C'* are the windings of the two transformers connected open-delta. Because of this arrangement the capacity of the two banks is only 80 per cent of the five transformers, or in this case $150 \times 5 \times 0.80 = 600$ kilovolt-amperes.

M. M. HENNELLY, Providence, R. I., explains that the question of operating the closed-delta and the open-delta transformer banks in parallel resolves itself into a case of a single closed-delta with two of its phases consisting each of two equal-capacity, equal-impedance transformers in parallel and the third phase consisting of one transformer with the same capacity and impedance as the others. In this case two of the phases will have a capacity of 300 kva. each with equal impedance and the third phase will have a capacity of 150 kva. with twice the impedance of the other two phases. This will result in an uneven distribution of load between the two 300-kva. phases and the 150-kva. phase in the order of 37.5, 37.5 and 25 per cent. Therefore, to limit the load on the 150-kva. phase to its rating will require the other two phases to be limited to $\frac{150}{25} \times 37.5 = 225$ kva. each, or an available total of $225 + 225 + 150 = 600$ kva. for the three phases. This is 80 per cent of the 750 kva. connected capacity.

TWO TRANSFORMER banks in parallel, each bank consisting of three single-phase transformers all alike, may still be operated in the event one transformer burns out, says E. P. Winters, Birmingham, Ala. All that need be done is to cut out the defective transformer by disconnecting its leads. No alteration in connections of the remaining five transformers will be required. The only effect this operation has is to reduce the capacity of the remaining transformers to 80 per cent of their normal rating.



Simplified diagram of an open-delta bank of transformers connected in parallel with a closed-delta bank

A SIMILAR suggestion is given by Clarence W. Hoyle, Lowell, Mass., for cutting out the defective transformers, and he points out that the combined capacity of the open-delta and closed-delta banks will be only 33⅓ per cent greater than the capacity of the delta-connected group, although the total transformer capacity is 66⅔ per cent greater. This he explains by the diagram, which on two phases has two transformers in parallel and a single transformer is connected to the third phase.

The current supplied by the bank is limited by the current which may be taken from transformer *A*. This, in turn, reduces the capacity of all other transformers, and the result is that the five 150-kva. transformers will carry only 600 kva. without overloading transformer *A*.

For example, the delta-delta connected transformers will carry $3 \times 150 = 450$ kva. Now, 33⅓ per cent of 450 is 150; therefore the capacity of the group is $450 + 150 = 600$ kilovolt-amperes.

If it were possible to supply the load without paralleling the transformers it would be better to supply part of the load with the open-delta bank and part with the delta-delta connected transformers. In open delta the transformers could be operated at 58½ per cent of their total ratings, which equals 175 kva. compared to 150 kva. if connected in parallel with the other bank.

R. V. STEVENSON of Malvern, Ark., is operating a closed-delta bank of transformers in parallel with an open-delta bank and gives his experience as follows:

We have two 7,500-kva. banks of transformers, one supplying a town about 60 miles away, the other bank delivering power to another town about the same distance from the plant. The two towns are about 60 miles apart, and their substations are tied together through a high-voltage line. While the transformer's banks are not in parallel on the secondary side at the plant, because of different voltages, they are in parallel through the two substations. At present we have to operate one transformer bank open-delta. The load on this bank is considerably more unbalanced than the other. The ampere readings at one instant on the open-delta bank were 600, 500 and 460, while at the same time the other bank read 940, 940 and 875.

THE BEST and most efficient combination is to operate two banks of transformers delta-delta; but if one unit becomes damaged it is possible to continue operation by connecting the two remaining units open-delta and in parallel with the bank of three units, assuming, of course, that the polarity is correct, is the opinion of Elmer N. Anderson, Austin, Minn. This is not an economical way to operate, but may be justified in an emergency or where it is desired to increase the capacity of an existing bank by adding spare transformers to save the investment for new transformers.

MATHEMATICAL explanations of the problem involved in the loading of the transformer were given by J. S. Newton, East Pittsburgh, Pa.; Doyle E. Haywood, Pasca, Wash.; G. E. Picket, Raleigh, N. C.; S. M. Zubair, Buffalo, N. Y.; Kennard Pinder, Wilmington, Del.; Victor N. Friedman, St. Louis, Mo.; and William M. Young, Rochester, N. Y.

WHAT'S NEW IN PLANT EQUIPMENT

Three-Element Feed-Water Control Regulates Water Input by Steam Flow and Water Level

WITH the increased rate of steaming of modern boilers, a much greater percentage of the volume below the surface of the water is occupied by steam. This has been found to be approximately 24 per cent in the case of a 26,000-sq.ft. cross-drum boiler equipped with water-cooled furnace walls. Since only 15 to 20 per cent of the total volume of water in a modern boiler is within the drum at normal water levels, the water level in the drum is seriously affected by changes in the rate of steaming. Furthermore, the water level is not a correct indication of the actual quantity of water in the boiler.

These conditions have necessitated the development of new feed-water controls that are unusually fast in operation in order to keep the level within normal limits during large changes in load. In some cases the only way to maintain the water level within safe operating limits is by a control which will maintain a high water level at high boiler ratings, thus providing increased storage so that the level will not drop below the water wall tube connections or below the drum when "shrinkage" takes place following a reduction in steaming rate.

The accompanying illustrations show a "three-element" feed-water control system developed recently by the Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, Ohio, to meet the new duties imposed by present-day boilers. The three elements from which this control is operated are steam flow from the boiler, feed-water flow to the boiler and water level in the boiler drum. To nullify the effect of "swell" and to maintain the rate of feed-water input more nearly equal to the rate of steam output, this control functions primarily from steam flow, but is modified slightly by water level when necessary, to hold the level within the desired limits.

The control is based on metered results. The three elements of steam flow, feed-water flow and boiler-water level are coordinated by means of linkage, as indicated diagrammatically in Fig. 1, to operate a selsyn sending device through a torque amplifier.

The linkage may be adjusted so that the water level in the drum is permitted to vary during normal operation, in accordance with the "swell" corresponding to the boiler rating. This insures maintaining a more nearly constant weight of water in the boiler instead of a constant water level. A low water level at low boiler ratings provides room for expansion with increased rating and thus tends to eliminate the possibility of moisture carryover. A correspondingly high boiler water level at high ratings also provides protection against a sudden loss of load with the consequent shrinkage of volume. Such an adjustment insures carrying sufficient water in the boiler drum to seal the water-cooled furnace-wall circulating tubes. The system may also be adjusted to maintain a substantially constant water level in the drum at all times. This is usually desirable in the case of extremely high pressure boilers, due to the fact that the specific volume of the steam approaches that of the water and the "swell" becomes negligible.

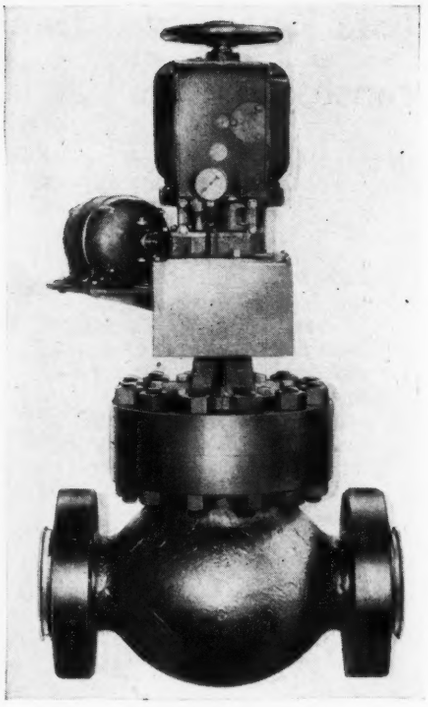


Fig. 2—Feed water control valve with self-contained motor driven oil pumping unit

The selsyn method of electrical transmission is used as the connection between the flow meters, which are the primary source of control, mounted on the boiler panelboard, and the feed-water regulating valve. A torque amplifier, controlled by the movement of the connecting linkage between the three elements, turns the selsyn sending unit at a rate proportional to the requirements for feed water. The receiving selsyn motor, mounted on the flow-regulating valve in the feed-water line, in turn moves a pilot valve in the flow-regulating valve from its neutral position. This applies oil pressure to the proper side of the operating piston, which opens or closes the valve to secure the required rate of flow. As the piston moves, the frame or stator of the receiving selsyn is rotated in such a way that the pilot valve is returned to its neutral position and the flow-regulating valve is held in the new position.

The selsyn hydraulic feed-water control valve, also shown diagrammatically in Fig. 1, is provided with its own motor-driven oil-pumping unit mounted directly on the valve, giving a self-contained unit and eliminating the necessity of extensive oil piping.

A valve-position indicator may also be placed on the operating panelboard below the meters so that the operators may know the position of the feed-water

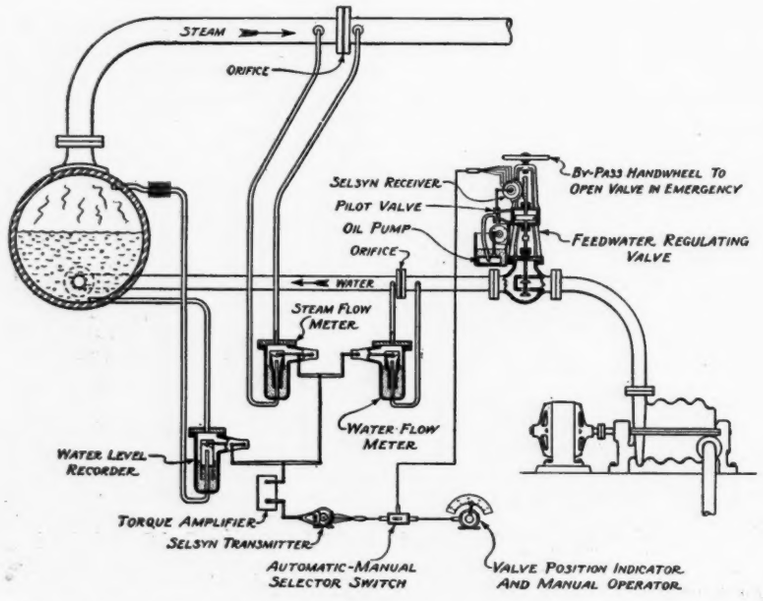


Fig. 1—Diagrammatic layout of Bailey three-element selsyn hydraulic feed water control

control valve at all times. A hand control is also incorporated which permits operation of the control valve independently of the automatic control. This involves the operation of a switch only, after which the valve may be positioned manually.

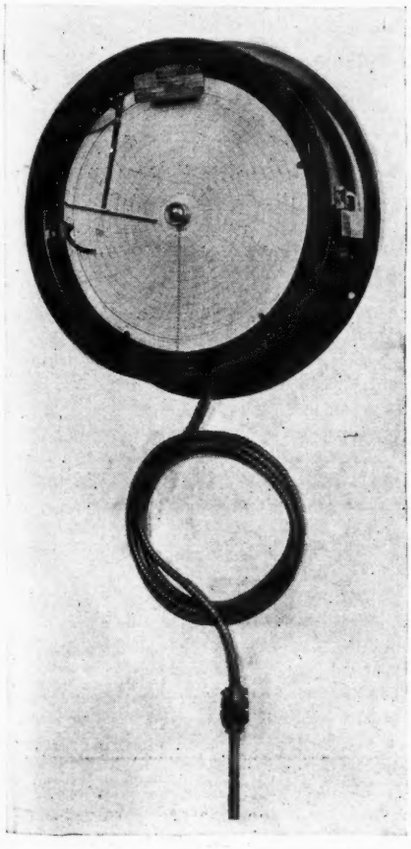
The three-element feed-water control valve, shown in Fig. 2, is designed for 1,600 lb. pressure service. It is a fully balanced tight-seating valve similar to the one used in the standard Bailey thermo-hydraulic feed-water regulator. The valve cage, which is readily removable for inspection or grinding, is provided with ports to give a straight-line flow characteristic.

Recording Thermometer Gives True Bulb Temperatures

EXTREME ACCURACY and freedom from the effects of ambient temperatures (case and tubing temperatures) are claimed for the new "Anti-Ambi" recording thermometer recently developed by the Foxboro Company, Foxboro, Mass.

The new thermometer is designed to give true bulb temperatures between 0 and 250 deg. at all times irrespective of variations in surrounding temperatures. The instrument contains no cams, compensating levers, bi-metallic strips, or retarding action of any kind.

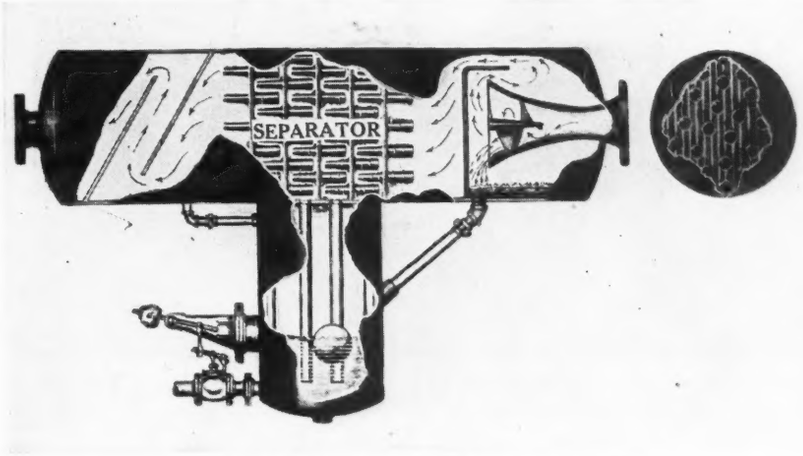
A special construction feature is found in the small bulb. The thermometer is so designed that it can make use of a sensitive bulb as small as one inch long. This feature is particularly useful in measuring temperatures in pipes.



Anti-Ambi recording thermometer

Steam Purifier Employs Series of Venturi Shaped Nozzles

EMPLOYMENT of a large volume of baffling effect and contact surface, and whirling and counter-flow action with a continuous increasing and decreasing of velocity through a multiplicity of nozzles characterizes the steam purifier for use on live and exhaust steam lines developed recently by the Farnsworth Company, Watertown, N. Y.



Farnsworth purifier for live and exhaust steam lines

Referring to the illustration, steam enters through a Venturi-shaped tube, in which its velocity is materially increased, then through a spiral expanding web and against a heavily ribbed conical-shaped baffle, where the heavier water particles are separated and the steam expands into a large receiving chamber. From this chamber the steam enters a series of Venturi-shaped nozzles arranged as shown in the illustration. Leaving the nozzles at high velocity, it strikes a ribbed baffled plate and is deflected in a direction counterflow to the inlet of another series of nozzles. This counterflow action and the speeding up and slowing down continues through five sets of baffles and nozzles. Upon leaving the last set of nozzles, it enters a large expanding chamber and passes around two inclined baffles to the outlet. A drain is provided between each set of baffles to a receiver from which the condensate is discharged through a float-controlled valve.

When used on exhaust steam lines the purifier is claimed effectively to remove all moisture, oil and dirt from the steam.

Spray Gun With Readily Adjustable Nozzle

ANY VARIABLE size of flat or round spray without stopping to change or adjust and set the gun nozzles is the outstanding feature of the new Thor Model 2 spray painting and finishing gun developed recently by the Binks Manufacturing Company, 3113 Carroll Ave., Chicago. This change in size and shape of spray by adjustment of the control screws at the back of the gun above the handle can be effected without stopping operations. All types of material from thin priming coats to heavy body lacquers and enamels can be atomized and applied.

In operating the gun the first pull on the two-finger trigger allows air to pass from the nozzle for cleaning the surface to be painted. Further pull on the trigger permits the paint to flow in the size and shape of spray designated by the adjustment. Self-centering of the air nozzle keeps it in alignment with the fluid tip. Connection of the air to the handle and of the paint supply near the nozzle balances the gun in the hand of the operator. As no paint comes in contact with the springs or air control parts, disassembling for cleaning is unnecessary. Ports having clear passage prevent clogging.

In accordance with operating requirements involving the method of supplying the paint, the proper combination of nozzle is applied. The same type is used for syphon cup and for gravity feed, in which air pressures of 40 to 60 lb. are used. For pressure feed containers the nozzle design is modified.

Construction of the gun includes a drop-forged body, die-cast handle, and a fluid nozzle of special stainless steel. The needle valve step is of alloy steel.

Spray gun with screw adjustment for varying size and shape of spray

NEWS of the FIELD

Diverse Array of Papers to Be Given at A.I.E.E. Winter Convention, Jan. 25-29

FOURTEEN technical sessions, representing the active progress of modern electrical engineering, are scheduled for the winter convention of the American Institute of Electrical Engineers, which will be held in New York City from Jan. 25 to 29, 1932. A wide selection of papers will be presented, covering the latest developments in steam and electrically driven power-plant auxiliaries, protective devices, electrical machinery, instruments, distribution, research, welding, transportation and communication.

In addition to the technical program, there will be interesting inspection trips, a smoker with special entertainment, presentation of the John Fritz Medal and Edison Medal, and the annual dinner-dance.

At the protective devices session on Monday afternoon the following papers will be read and discussed: "The Theory of Oil-Blast Circuit Breakers," D. C. Prince; "A New High-Speed Distance Relay With Composite Impedance —Reactance Characteristic." S. L. Goldsborough and W. A. Lewis; "Extinction of A.-C. Arc in Turbulent Gases," T. E. Browne, Jr.; "Recent Developments in Arc-Rupturing Devices," R. C. Van Sickle and W. M. Leeds; and "The Practical Application of the Oil-Blast Principle of Circuit Interruption," R. M. Spurck.

The selected subjects to be presented at the Tuesday afternoon session include: "Steam vs. Electrically Driven Auxiliaries for Steam Power Stations," F. H. Hollister; "Steam-Driven Auxiliaries for Power Plants," W. Poole Dryer; and "Electrically Driven Auxiliaries for Steam Power Stations," L. W. Smith.

Two sessions on electrical machinery will be held on Thursday, with the following papers: "An Induction Motor With Parallel Rotor and Stator," A. G. Conrad and R. G. Warner; "Some Considerations in the Design of Damper Windings for Synchronous Motors," C. C. Shutt; "Surge-Proof Transformers," H. V. Putnam; "Effect of Transient Voltages on Power Transformer Design IV — Transformation of Lightning Waves to Secondary Windings," K. K. Palueff and J. H. Hagenguth; "Commutation Considered as a Switching Phenomenon," R. E. Hellmund and L. R. Ludwig; "Equalizing Currents in the Armature of a D.-C. Machine," R. M. Baker; "Calculation of the No-Load Damper Winding Loss in Synchronous Machines," E. I. Pollard; and "Mathematical Theory of Sine-Wave Generators," L. P. Shildneck.

On Friday afternoon the welding session will be devoted to a consideration of the following papers: "Forces of Electric Origin in the Iron Arc—An Explanation of Overhead Welding," F. Creedy, R. O. Lerch, P. W. Seal and E. P. Sordon; "An Improved A.-C. Arc Welder," A. M. Candy; and "The Fundamentals of the Design of Arc-Welding Generators," K. L. Hansen.

Members of the winter convention committee are: E. B. Meyer, chairman; O. H. Caldwell, H. P. Charlesworth, Harold C. Dean, W. H. Harrison, C. R. Jones, G. L. Knight, C. E. Stephens and R. H. Tapscott. Chairmen of the subcommittees are: C. E. Stephens, convention executive committee, with C. R. Jones as vice-chairman; W. G. E. Draper, smoker; E. J. Johnson, dinner-dance; W. R. Smith, inspection trips; and Mrs. E. B. Meyer, ladies entertainment.

Appointment of G. O. Smith Upheld by District Court

THE RIGHT of George Otis Smith to hold his office as Chairman of the Federal Power Commission, despite the Senate's demand upon President Hoover for reconsideration of its action in consenting to the nomination of Mr. Smith, was upheld on Dec. 5 by the Supreme Court of the District of Columbia.

When the Senate, in conformity with its own rules, unanimously ordered notice of its consent to the appointment of Mr. Smith to be sent to the President, it surrendered its control of the matter and its right to reconsideration of its action, Justice Peyton Gordon ruled in his opinion. The President was then free, he declared, to make a constitutional appointment.

The court's decision was handed down in the case of United States of America v. George Otis Smith, No. L. 79553 (*Power*, Feb. 10, 1931). The Senate of the United States was denied its petition for a writ of quo warranto against Mr. Smith by which it sought to require him to show by what right he holds the office of member of the Power Commission.

The Senate's petition to the court also requested that if it be shown that he "usurped, intruded into and unlawfully holds the said office that he be ousted and excluded therefrom." This request was refused by the court.

Senator Walsh of Montana, stated orally after the decision was announced that an appeal would be taken to the Supreme Court of the United States.

2,760-Hp. Diesel Plant for Flour Mill Nears Completion

WORK IS NOW nearing completion on the diesel-engine installation of the Commander Milling Company, Minneapolis, Minn., which will be one of the largest industrial diesel plants in the United States, and the largest flour-mill diesel plant in the world, so far as is known.

The new equipment consists of three 800-hp. solid-injection, two-stroke-cycle engines complete with direct-connected alternators, motor-generator sets, ten-panel switchboard and all auxiliary equipment, housed in a special new power plant building 80x40 ft. Another 360-hp. engine which has been in use in the same mill for the past few years, will be moved to the new plant and used for power loads, lighting, etc.

The diesel engines will replace steam equipment and provide additional power for future requirements. They will be paid for out of savings in operation over the cost of purchased power. The high efficiency of the diesel plant will make possible the retirement of the investment in approximately six years, and will give the Commander company the lowest production cost of any of the larger mills in the Northwest today.

Safe Harbor in Service 9 Mo. Ahead of Schedule

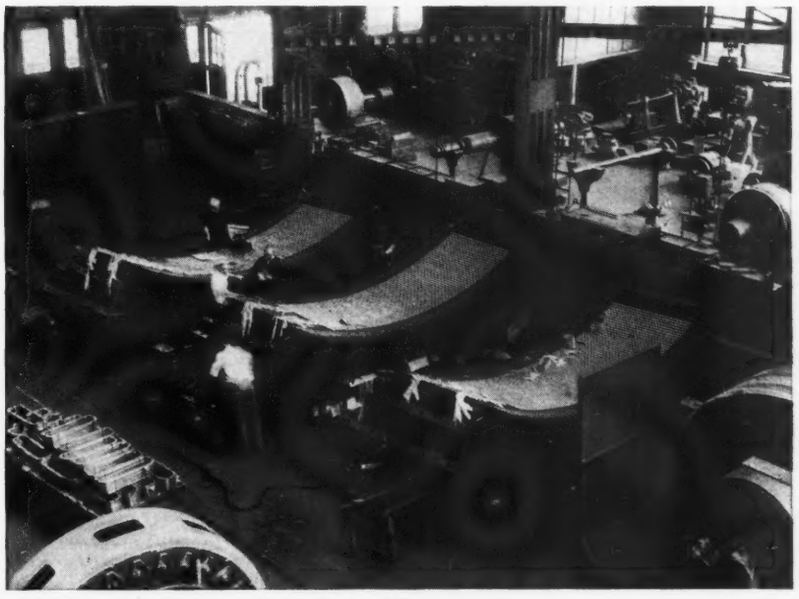
THE FIRST TWO 42,500-hp. units in the $30,000,000 hydro-electric development of the Safe Harbor Water Power Corporation at Safe Harbor, Pa., on the Susquehanna River, went into service last week, nine months ahead of schedule. The first power sent out over the recently completed 220,000-volt transmission line went to Baltimore, Md., for distribution by the Consolidated Gas, Electric Light & Power Company, part owner of the project along with the Pennsylvania Water & Power Company at Holtwood.

Two more units of the same size

will be ready for operation early in 1932. The initial installation at Safe Harbor will consist of six turbines with a total capacity of 255,000 hp. Six additional units are planned, which will give the plant an ultimate capacity of 510,000 horsepower.

The development begins operation with its entire output sold. It will be operated as a unit in the system which includes the 180,000-hp. hydro-electric plant at Holtwood and the 346,000-hp. steam stations in Baltimore. This system connects with the power lines of the Electric Bond & Share, Insull and United Gas Improvement systems in Pennsylvania. Under a twenty-year contract, recently signed, it will supply power to the electrified main line of the Pennsylvania Railroad between Perryville, Md., and Washington, D. C.

LARGEST HYDRO GENERATORS FOR U.S.S.R.



A small part of one of the world's largest hydro-electric generators is here shown in process of construction in the Schenectady Works of the General Electric Company. The three sections form half of the stator frame for one of the 77,500-kva. generators, which will be installed at the 800,000-hp. Dnieper River development in the Soviet Union. The weight of a complete stator with punchings and windings is 352,000 pounds

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Conference Board Analyzes Competitive Status of Coal

THE COAL INDUSTRY of the United States has suffered to a greater degree than that of any other of the great coal-producing countries from the competition of other fuels and from the rapid progress of fuel efficiency in general, according to an analytical report on "The Competitive Position of Coal in the United States," just completed by the National Industrial Conference Board.

The report presents an analysis of consumption of coal by uses and groups of consumers and by regions, and a review of the competitive situation in both the anthracite and the bituminous coal industries and of the economic problems that confront them today. It shows that in 1913 coal supplied 88 per cent of world energy production, but since then the relative importance of coal among the energy producing sources has declined, until in 1930 its share of the total energy output was only 72 per cent.

In reference to the frequently suggested plan for governmental control of the industry through the powers of the Interstate Commerce Commission to regulate freight rates and car distribution, the Conference Board says that such a plan "can at the most act only as a palliative to the ills of the industry. Constitutional limitations on the powers of the federal government preclude such measures and make it necessary to look in a different direction for a solution of the existing maladjustments in the coal industry. The alternative is a reconstruction of the coal industry from within."

The report finds that there are many signs of progress toward reconstruction from within in the bituminous industry and points to the fact that since 1920 1,665 companies have been eliminated from the field. During the same period the prices of coal have fallen, and the number of miners has decreased. More recently the length of the working year has been increased, and the output per man has risen. When this costly process of deflation is completed, the survivors will face the problem of building a more permanent structure for the future.

Work on Madden Dam Plant to Start Soon

CONSTRUCTION of the Madden Dam project on the Chagres River near the Panama Canal Zone will start early next year, according to present plans of the federal government. Bids for supplying the plate-steel penstocks and outlets pipes to be installed in the Madden power plan were opened Dec. 10. Bids have already been received for the construction of the dam, power house and appurtenant works, but as yet the contract has not been let.

In design the new dam will be of the gravity type, with its main section 900 ft. long, 200 ft. high at the maximum point and 180 ft. wide at the base. When completed it will enlarge the facilities of the Panama Canal four times, prevent floods and store water for the generation of electricity.

The power installation will consist ultimately of three 6,600-volt, 25-cycle generators direct conected to three 11,200-hp. water wheels. The latter will operate on a variable head of 75 to 145 ft., depending on the amount of water needed to maintain proper traffic level in the canal.

Missouri Commission Lacks Power Over Municipal Plants

THE Missouri Public Service Commission is without jurisdiction to regulate the acts or the rates of municipally owned electric light plants, according to a decision of the State Supreme Court.

The opinion, which was written by Judge Frank E. Atwood, was handed down last week in connection with an injunction suit filed by the electric light plant at Columbia, a municipal plant, to prevent the commission from proceeding with its announced intention of making an inventory and appraisal of the properties with a view to readjusting the power rates.

The case had its origin when a group of citizens filed a petition with the commission protesting that the rates charged by the Columbia municipal plant were excessive and requested the commission to make an appraisal of the property and order a new and fair rate. The municipally owned plant then filed the injunction proceeding.

The Supreme Court held that the portion of the Public Service Commission Act giving the commission power to regulate municipally owned utilities is invalid, because the title of the act does not specifically state that the measure contains such provisions.

"Had it been the intent of the Legislature to provide for control of municipalities," the opinion said, "it is fair to assume that the title would have so stated."

Hydro Research Institute Started at Iowa University

ORGANIZATION of the Iowa Institute of Hydraulic Research has just been announced "to afford as agency for the coordination of the talent, facilities and the resources that may be made available at the University of Iowa for undertaking projects of unusual magnitude, scope or complexity in the field of hydrology and hydraulic engineering."

Floyd A. Nagler, professor of hydraulic engineering at the university, is director of the new institute. Associate directors are David L. Yarnell, senior engineer of the United States Bureau of Agricultural Engineering, and Martin E. Nelson, assistant engineer in the United States Engineer Office, St. Paul District. Frederic T. Mavis, Joseph W. Howe and J. Stuart Meyers, of the university faculty, are associate engineers.

Investigations will be conducted under the direction of the operating staff and co-operating engineers. Consultants from the cognate departments of the university faculty will be available for counsel, either as a group or singly, concerning aspects of hydraulic problems which involve their respective fields. The practical engineering value of the research undertaken is advanced through the association with the institute of an advisory committee of prominent practicing hydaulic engineers, of which Clement C. Williams, dean of the engineering college, is chai.man.

The institute is an integral part of the university and is administered accordingly. It affords a connection through which technical societies, governmental departments, municipalities, industries, power corporations, and other interested parties may effectively cooperate with the university in the field of hydraulic research.

Engineers Committee Drive For Relief Fund Started

THE Professional Engineers Committee on Unemployment has raised over $19,000 in cash and has received pledges for a considerable sum in addition, according to an announcement by H. de B. Parsons, chairman of the committee.

Approximately 680 engineers have registered with the committee, of which number about 300 are reported to be destitute, Mr. Parsons says. Jobs have been found for 149.

The committee, with headquarters in the Engineering Societies' Building, 29 West 39th St., New York City, was recently organized by the four national engineering societies: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers.

It is estimated that more than $200,000 will be required to carry out the relief program. Funds are being solicited and members of the metropolitan sections of the four founder societies have been asked to aid in locating positions for the needy.

Dean Joseph W. Barker of the Engineering School of Columbia University reports that more than a score of professional men have availed themselves of the university's offer to open engineering classes to the unemployed engineers "without fee or credit."

Donald Fraser, Director of Chain Belt Company, Dies

DONALD FRASER, director and former vice-president of the Chain Belt Company, Milwaukee, Wis., died on Nov. 20. He was 78 years old.

Mr. Fraser, formerly engaged in the pattern-making business in Minneapolis and Milwaukee, became associated with the Chain Belt Company in 1895. He was very active in the early developments of the company, contributing many important inventions to the chain business. Subsequently he became vice-president and works manager, retired in 1917, and was made a director of the company. He was also a director of the Sivyer Steel Casting Company and the Federal Malleable Company, both of Milwaukee.

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COMING CONVENTIONS

American Society of Mechanical Engineers. Spring meeting at Bigwin Inn, Lake of Bays, Ont., Canada, June 27-July 1. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual winter convention in New York City, Jan. 25-29, 1932. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Heating and Ventilating Engineers. Annual meeting and exposition, Hotel Statler, Cleveland, Ohio, Jan. 25-29. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

American Society of Refrigerating Engineers. Joint meeting with the A.S.H.V.E. and annual convention at the Hotel Cleveland, Cleveland, Ohio, Jan. 26-29, 1932. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Water Works Association. Annual convention at the Hotel Peabody, Memphis, Tenn., May 2-6, 1932. Secretary, Beekman C. Little, 29 West 39th St., New York City.

National Marine Engineers Beneficial Association. Annual convention at the Hotel Jefferson, St. Louis, Mo., Feb. 8-12. Secretary-Treasurer, Albert L. Jones, 313 Machinists' Building, Washington, D. C.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 6-10. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

Opposition to St. Lawrence Project Growing in Quebec

STIFF OPPOSITION to the St. Lawrence Waterways development project is looming up in the Province of Quebec. During a recent sitting of the Legislature a motion was introduced by Athanase David, provincial secretary, expressing the opinion that the scheme was premature, that its enormous cost would weigh upon Canada, already heavily taxed, and that, before developing international hydraulic powers destined to be useful to the United States, it was preferable to use those powers which are Canadian.

Supporting his motion, Mr. David stated that on not one of three counts does the internationalization of the St. Lawrence waterways appeal to the province generally. The three counts on which he summed up the matter were, first, navigation; second, power; third, the cost. He found the scheme was not justified from a power point of view because there is plenty of power available for the province now, and also for the future, even to the time when the province will have 20,000,000 people. He quoted reports of engineers in support of his contention that the project would not improve navigation on the river, in that the creation of necessary dams and other works would inevitably interrupt the flow of water from the Great Lakes to the St. Lawrence.

J. E. Perrault, minister of roads and mines, asserted that the province of Quebec had no presents to give to the United States. He had a lot of reasons which favored the David motion, notably as regards the project being premature, and, further, he was of opinion that when the time for development did come the scheme should be an entirely Canadian one.

New Kieley & Mueller Plant Soon Ready for Production

KIELEY & MUELLER, INC., are completing arrangements for production at their new plant, 40 Paris St., Newark, N. J., where 25,000 sq.ft. of floor space will be devoted to the manufacture of a full line of steam, water and air specialities. Production schedules call for work to start shortly after the first of the year.

Steady growth of its business, the company states, has necessitated opening this new plant, which is modern in design, well lighted and ventilated. The space and physical layout of equipment are arranged to facilitate operation in an efficient manner.

The main office of the firm will remain where it has been for over half a century, at 34 West 13th St., New York City, where also a warehouse with complete stock will be retained for servicing the metropolitan area.

Personals

CARL STRIPE, who has been editor of *Combustion* since its inception in July, 1929, has resigned to establish a new monthly publication to be known as *Steam Plant Engineering*. Mr. Stripe has had a wide experience in the steam plant field as engineer in the stoker department of the Westinghouse Electric & Manufacturing Company, and later as sales engineer, district manager and publicity director of the Combustion Engineering Corporation. CHARLES MCDONOUGH, who has been associated with Mr. Stripe in publishing *Combustion*, will succeed him as editor.

J. F. DAVENPORT has been appointed superintendent of hydro-electric generation of the Southern California Edison Company, it was announced recently by FRED G. HAMILTON, manager of operation. Mr. Davenport, who has been with the Edison organization for the past five and half years, will succeed J. M. GAYLORD, who resigned to become chief electrical engineer of the Metropolitan Water District of Southern California.

R. B. TENNEY, JR., formerly engineer of the Texas Power & Light Company, Dallas, is now consulting engineer in that city for the Power Cost Engineering & Appraisal Corporation, of San Antonio, Tex.

ADALBERT VON GONTARD, chief engineer of Anheuser-Busch, Inc., St. Louis, Mo., has been appointed chairman of the Oil and Gas Power Committee of the St. Louis Section of the American Society of Mechanical Engineers for the coming year. Other members of the committee are: E. J. BROCK, president of the Brock Engineering Corporation; HANS KURTH, assistant chief engineer of the Fulton Iron Works Company; E. E. PENDRAY, of Fairbanks, Morse & Company; and RUDOLF SCHLATTER, engineer of the Busch-Sulzer Bros. Diesel Engine Company.

P. R. FARROW, who prior to Nov. 15 was resident engineer for the Kaministiquia Power Company, Kakabeka Falls, Ont., Canada, is now manager of operations for the Ontario Power Service Corporation at Fraserdale.

D. B. TAYLOR, formerly resident engineer in the Albany district of the New York Power & Light Corporation, has taken over the superintendency of the Schenectady district of that company.

R. N. BENJAMIN, E. J. ARCHBOLD and F. H. BURGHARD have returned to the engineering department of the Georgia Power Company in Atlanta, after spending four years in the Birmingham (Ala.) office of the recently dissolved firm of Allied Engineers, Inc., and its predecessors. Messrs. Benjamin, Archbold and Burghard were former members of the Georgia Power Company's engineering department.

How's Business?

MOST DISTURBING detail of a dismal week is the indifferent, almost stupid, response to the fundamental, hopeful and necessary measures of reconstruction suggested in the President's message, according to *The Business Week*, Dec. 16. This indicates the degree of demoralization of public opinion produced by the persistent decline of business activity, renewed weakness in commodity prices and establishment of new low levels in security markets as December sets in. Continued delay in automotive demand, and price uncertainties, are letting steel activity down into the usual year-end slump, and most indicators except power production appear to be making up for the unseasonal bulge in October by more rapid seasonal recession during December.

Power production by public utilities for the week ended Dec. 5 was 1,671,466,000 kw.-hr., or 4.3 per cent below the corresponding period of 1930, according to N.E.L.A. figures.

Business Notes

MASON REGULATOR COMPANY, Boston, Mass., has acquired the NEILAN COMPANY, LTD., Los Angeles, Calif., according to an official announcement just made public. Complete engineering, manufacturing, sales and service activities will be maintained in both Boston and Los Angeles, the announcement states, and the distribution network of each company will be considerably broadened. Terms of the transaction were not divulged, but the deal is believed to be one of the most important ever made in the regulator business.

FARNSWORTH COMPANY, Watertown, N. Y., announces that the Bagley & Sewall Company will in the future manufacture all its various types of equipment and systems. The offices of the two companies are located in the same buildings in Watertown.

PLIBRICO JOINTLESS FIREBRICK COMPANY, Chicago, Ill., recently received United States Patent No. 1,828,618, which covers anchors allowing expansion and contraction of a monolithic furnace lining. The Carolina Refractories Company has a limited license to manufacture a chain-type anchor, the company states.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S (East Pittsburgh, Pa.) industrial relations program was judged one of the best in the country and awarded a prize of $200 in a contest recently conducted by B. C. Forbes. Evolved in more than 40 years of the company's corporate existence, the program includes all fundamental welfare policies necessary to any modern industrial concern.

KEASBY & MATTISON COMPANY, Ambler, Pa., announces that A. B. Spaulding, formerly assistant manager of the Philadelphia branch, has been transferred to the Ambler headquarters office, to become manager of the public utilities department of the company.

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Trade Catalogs

WATER WALLS, PREHEATERS — Bulletin No. 70, just issued by the Edge Moor Iron Company, Edge Moor, Del., describes the company's water walls and air preheaters and presents general information on the applications of this equipment. It is attractively illustrated with shop pictures showing construction features of the units, blueprints of typical installations and photographs of units in service.

OIL RECLAIMER — "Reclamation of Electrical Oils" is the title of a new bulletin issued by S. F. Bowser & Company, Fort Wayne, Ind. It describes and illustrates the construction and operation of the Bowser "Uni-Pass" oil reclaimer, and reviews briefly the insulating-oil reclamation processes in use today.

PRESSURE CONTROL—Details of construction and operation of the Neilan pressure controller and ball-bearing diaphragm control valve are contained in illustrated Bulletin No. 2050-B, recently issued by the Neilan Company, Ltd., 641-651 Santa Fe Ave., Los Angeles, Calif.

INSULATED CABLE—Bulletin No. 10-A, just issued by the Rockbestos Products Corporation, P. O. Drawer 1102, New Haven, Conn., contains descriptions and specifications of "Rockbestos" insulated wires and cables for 600 to 7,500-volt service; also switchboard wire, multiconductor control cable, lead-sheath control cable, etc.

MOTOR-GENERATORS—The design and performance of Elliott motor-generator sets are described and ilustrated in Bulletin O-1, recently issued by the Elliott Company, Jeannette, Pa. Numerous installations are shown in the bulletin.

OIL BURNERS — A new illustrated catalog, published by the Enterprise Oil Burner Company, 2902 Nineteenth St., San Francisco, Calif., presents full details of a number of improved oil burners for use in power plants, industrial and office building heating plants, home and marine service.

NEW PLANT CONSTRUCTION

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Conn., Noank — East Coast Ship & Yacht Corp., H. F. Morse, Pres., completed plans for construction of storage buildings, sheds, under cover storage basin, three turntables, electric handling equipment, etc., for shipyard. Estimated cost to exceed $50,000.

Fla., St. Petersburg — Veterans' Administration, Arlington Bldg., Washington, D. C., will receive bids until January 5 for construction of a group of buildings including refrigerating and ice-making plant, etc., at Veterans' Administration home here.

Ga., Augusta — Augusta Canal Commission, will receive bids about February 1 for construction of first unit of electric light and power plant including five 3,000 hp. Diesel engines. Burns & McDonnell Engineering Co., 406 Interstate Bldg., Kansas City, Mo., are engineers.

Ill., Chicago—Chicago Union Station Company, awarded general contract for construction of a new power house at Chicago River midway between Taylor St. and Roosevelt Road to John Griffiths & Sons Co., 228 North La Salle St., boilers, to Foster-Wheeler Corp., 20 North Wacker Drive and conveyors to Link Belt Co., 910 South Michigan Ave. Estimated total cost $1,500,000. Work is under way.

Ill., Chicago — U. S. Engineers Office, War Dept., Washington, D. C., awarded contract for electrical equipment for Lockport, Marseilles and Starved Rock locks on Illinois waterway here, to Wadeford Electric Co., 205 West Wacker Dr. $64,356.

Ia., Adel—Iowa Power & Light Co., plans to expend $55,000 for improvements to plant, including installations of new lines, equipment, etc. Private plans. Fred C. Macy, Manager.

Ia., Milford—City Council plans an election to vote $80,000 bonds for construction of municipal light plant. F. H. Merritt, Mayor.

Ia., Spencer—City plans construction of new waterworks system including drilling of ten wells, pumping station, etc. Estimated cost to exceed $25,000.

Mass., Lowell — City plans alterations to pumping station including new boilers at Pawtucket Blvd. Estimated cost $25,000. Private plans. James G. Hill, Supt. of Water Dept.

Mass., Norfolk — Commonwealth of Massachusetts, Dept. of Correction, State House, awarded contract for boilers to International Engineering Works, Framingham; stokers to Detroit Stokers Co., 201 Devonshire St., Boston, and coal handling equipment to Colwell & McMullen, 31 St. James Ave., Boston, for State Prison Colony here.

Mass., Quincy (Boston P. O.)—Commonwealth of Massachusets, Metropolitan District Commission, awarded contract for two pumping units for Squantum pumping station to Turbine Equipment Co., of New England, 80 Federal St., Boston.

Mass., South Hadley—Mount Holyoke College, Mary E. Wooley, Pres., having preliminary plans prepared for construction of a 2 story, 50 x 100 ft. boiler house, including three 350 hp. water tube boilers. Estimated cost $200,000. Office of Hollis French, 210 South St., Boston, Archt.

Mich., North Muskegon—City is having plans prepared for construction of a sewage disposal plant and pumping station. Estimated cost $60,000. Boulay Harrison Co., 914 Summit St., Toledo, O., are engineers.

Minn., Duluth—City plans enlargement and remodeling of Lakewood pumping station including new boilers and accessories, replacement of steam driven pumps and pipes, installation of low head pumps, etc. Estimated cost $120,000. E. W. Kelly, City Engr.

N. J., Asbury Park—Saverio Poluso, Lincoln Place, awarded contract for construction of an ice plant to William A. Taylor, 1 Lincoln Place. Estimated cost $40,000.

N. J., Orange—Board of Commissioners, City Hall, rejected bids received Sept. 1 for construction of water pumping station and electric light plant at Chestnut St. $435,000. Runyon & Carey, 31 Fulton St., Newark, Engrs. Project may be abandoned.

N. J., Scotch Plains—Board of Chosen Freeholders, Court House, Elizabeth, awarded contract for a 1 story addition to power house and garage building at Bonnie Burns Sanitorium here, to Thomas F. Conroy, 95 Tiffany Pl., Maplewood. Estimated cost $40,000.

N. J., South Orange—Town will receive bids until December 18 for construction of water pumping station, pumping equipment and control apparatus at southwesterly end of Crest Drive. $15,000. Ira T. Redfern is city engineer. Weston & Sampson, 14 Beacon St., Boston, Mass., are consulting engineers.

N. Y., Lowville—Lowville Gas Co., plans construction of a gas plant. Estimated cost to exceed $50,000. Johnson Church & Co., 149 Broadway, are architects.

N. Y., Plymouth—Leon T. Stewart, has been granted permit by Public Service Commission, to construct electric light plant in Chenango county.

N. C., Greensboro—Swift & Co., Packers and Exchange Aves., Chicago, Ill., plans construction of cold storage plant here. Estimated cost $40,000.

O., Columbus—Dept. of Welfare, Ninth and Oak Sts., awarded contract for installation of boilers in connection with heating plant at State Penitentiary to Babcock & Wilcox Co., Guard Bldg., Cleveland. $85,080.

Okla., Seminole—City is preparing preliminary plans for construction of a municipal electric light plant. Estimated cost $60,000. R. N. Geer, Seminole, is engineer.

Pa., Morganza—Pennsylvania Training School, awarded contract for new engine and generator in connection with power plant improvements to Dravo Doyle Co., 302 Penn Ave., Pittsburgh. $17,380.

Pa., Philadelphia—Pennsylvania R.R., Broad St. Station, awarded contract for transformers and electrification equipment to Allis-Chalmers Co., West Allis, Wis. Estimated cost $1,000,000.

R. I., West Warwick—Warwick Gas Co., c/o Johnson Church & Co., 149 Broadway, New York, Archts., plans construction of a gas plant here. Estimated cost $40,000. Maturity in summer or later.

Tenn., Cookeville—City Commissioners, plans installation of an auxiliary electric light plant to include a Diesel engine. Estimated cost $60,000.

Wash., Prosser—Bureau of Reclamation, Department of Interior, Denver, Colo., will receive bids until December 30 for construction of power canal, power plant and alterations to diversion dam Yakima project, near Prosser.

Vt., Burlington—Home for Aged Women, 272 Church St., having plans prepared for construction of a heating plant on Church St. Estimated cost $45,000. Frank L. Austin, 240 College St., is engineer.

Ont., Toronto — Imperial Order Daughters of the Empire, c/o F. H. Wilkes, 96 Bloor St. W., Archt., plans construction of a preventorium to include administration building, hospital, central heating plant, etc. Estimated cost $500,000.

Equipment Wanted

Engine, Switchboard, etc.—West Bend, Ia.—City Council, plans to purchase a Diesel engine unit with alternate and direct connected exciter, a.c. switchboard, 90 kva. alternator and exciter for present 120 hp. engine, etc., for proposed improvements to electric light plant.

Motors—Cambridge (Boston P. O.), **Mass.**—J. L. Gleason & Co., 207 Bent St., plans to purchase 2 to 25 hp. motors, 550 v. 3 ph., 60 cycle.

Motor—Lynn, Mass.—H. A. Littlefield & Co., 20 Avon St., plans to purchase 100 or 150 hp. motor, 220 v., 720 or 900 r.p.m. 60 cycle self-starting, synchronous with starter.

Pump and Motor—Fallon, Nev.—Town Board, is receiving bids for furnishing and installing deep well turbine pump and motor in connection with waterworks. Estimated cost $15,000.

Condenser, Pump, etc.—Brooklyn, N. Y.—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until December 16 for installation of 1,500 kw. turbo-alternator furnished by Government and furnishing and installing surface condenser, motor driven condensate pump, air cooling system of ventilation for alternator, switchboard panel, etc., for Navy Yard here.

Pumps, etc.—Oregon, Wis.—Board of Control, A. W. Bayley, Secy., Madison, will receive bids until December 28 for sludge pumps, deep well turbine pumps, dry feeders, etc., for lime soda ash water softener plant at Industrial School for Girls here.

Compressor—London, Ont.—London Farmers Dairy, 772 Dundas St., plans to purchase ammonia compressor with brine tank two to six ton capacity.

Industrial Projects

Ind., Elkhart — Illinois Carton Co., 2601 North Crawford St., Chicago, Ill., awarded contract for construction of a 1 story, 130 x 200 ft. factory at Clark and Elkhart Sts., to George Kistner & Son, 914 South Main St. Estimated cost $40,000.

Ind., Evansville—Servel Sales Inc., awarded contract for addition to factory for the manufacture of electric refrigerators at 19 Morton Ave., to M. J. Hoffman Construction Co., 20 North Fourth St. Estimated cost $40,000.

Ind., Muncie — Indiana Steel Wire & Co., awarded contract for construction of a 1 story, 60 x 280 ft. factory on Jackson St., to Albert Glaser, 610 South Jefferson St., Muncie. Estimated cost $40,000.

Mass., Chicopee—Palmer Steel Co. Inc., 1694 Main St., Springfield, will build two factory units, 60 x 360 and 80 x 160 ft., each 1 story, on Meadow St., here. Estimated cost to exceed $40,000. Private plans. Work will be done by owner's forces.

Mich., Battle Creek—Kellogg Co., plans construction of a power plant, including boilers and coal and ash handling equipment for cereal factory. Estimated cost $75,000. Albert Kahn, 1000 Marquette Bldg., Detroit, is architect.

Mich., Muskegon — Alaska Refrigerator Co., Muskegon, subsidiary of Norge Corp., 7601 Central St., Detroit, plans re-equipping electric refrigeration manufacturing plant. Estimated cost to exceed $100,000. Work will be done by day labor and separate contracts.

Miss., Greenville—Planters Gin & Milling Co., E. D. Davis, Pres., plans to rebuild cotton gin plant destroyed by fire. Estimated cost $65,000 including equipment.

N. J., Edgewater—Lever Bros., 371 7th Ave., New York, N. Y., awarded contract for superstructure of a 1 and 2 story soap manufacturing plant including 60 x 65 ft. boiler house, 60 x 100 ft. refinery, 60 x 115 ft. deodorizing building and 65 x 185 ft. finishing building on River Road here, to White Construction Co., 95 Madison Ave., New York. Estimated cost $40,000.

N. J., Jersey City—Gibraltar Electric Clock Co. Inc., Joseph Gottlieb, Pres., 66 Nassau St., New York, N. Y., plans alterations to and re-equipping of manufacturing plant at Bramhall, Woodward and Van Horne Sts. here. Estimated cost to exceed $40,000. Architect and engineer not selected.

N. J., Newark—Star Electric Motor Co., 140 Miller St., will soon award contract for construction of a 1 story, 160 x 220 ft. factory on Riverside Ave. Estimated cost $40,000. J. Di Stasio & Co., 136 Liberty St., New York, are architects.

Pa., Beaver Falls — Mayer China Co., completed plans for rebuilding power plant and mould factory at Second Ave. and Fourth St., destroyed by fire. Estimated cost $200,000. Private plans.

Texas — Gladewater Refining Co., Gladewater, plans construction of a casinghead gasoline refinery in East Texas fields. Estimated cost $100,000.

Man., Winnipeg—National Battery Co., G. P. Castner, V. Pres., 1728 Roblyn Ave., St. Paul, Minn., plans construction of a plant here. Estimated cost $100,000.

Ontario—Cities of Fort William and Port Arthur, voted for bylaw permitting Hamilton By-Product Coke Ovens, Ltd., 4 Hughson St. S., Hamilton, to construct gas and coke plant, including distribution system, etc. Estimated cost $1,000,000.

Ont., Toronto—United Typewriter Co. Ltd., 354 Victoria St., Toronto, subsidiary of Underwood-Elliott-Fisher Co., 342 Madison Ave., New York, N. Y., plans addition to plant for the manufacture of parts here.